

Illinois Ready Mixed Concrete Association

IRMCA News

Special Edition

Volume 27, Number 2

Summer 2008

Sustainability: The Concrete Advantage

- **How concrete earns LEED points**
- **Concrete's role in stormwater management**
- **How the industry is promoting concrete's green attributes**
- **Sustainable curriculum at universities**



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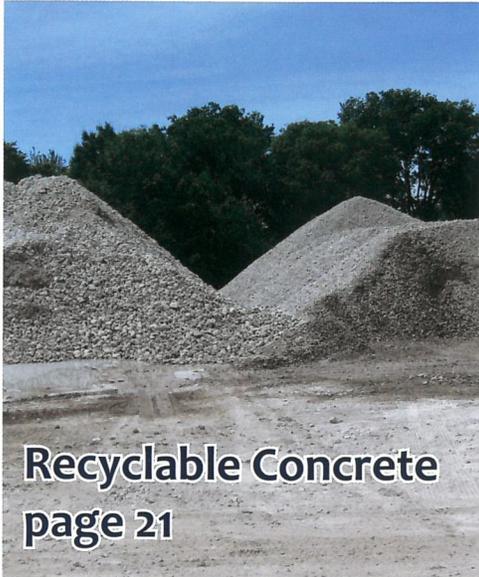
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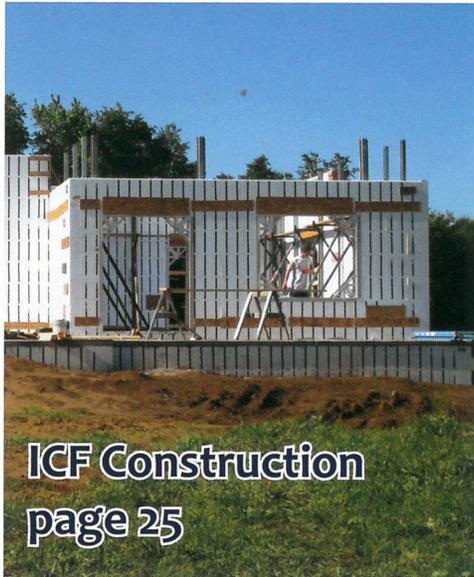
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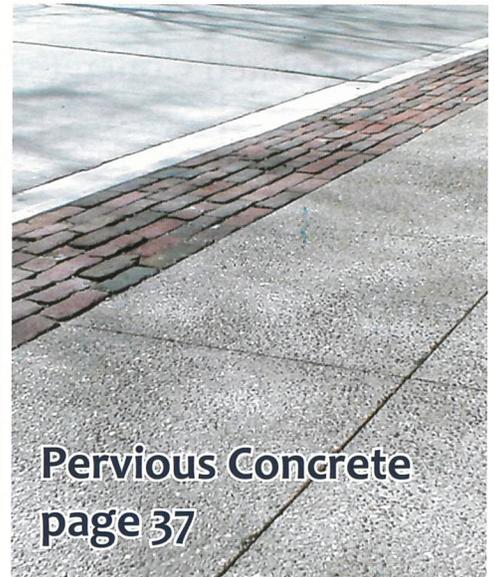
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Mission

To be the voice for the ready mixed concrete industry in Illinois. To promote the use of quality ready mixed concrete through innovative educational programs. To accomplish common goals as an organization that cannot be done individually.



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Concrete – The Sustainable Choice

Welcome to a very special issue of IRMCA News!

We are living in a very environment-conscious society. The “green” movement is on! In every aspect of our lives decisions are being reached only after considering the effect of those decisions on the environment. Advertisers can't seem to use the word “green” enough as they attempt to identify their products with this popular movement; it's a pretty savvy thing to do, a no-brainer. In our industry, I'm convinced that each and every major building or paving evaluation made from now on will be made with one very discernible eye on the resulting effects on the environment.

My friends, we deal from strength! I strongly believe that our primary product, ready mixed concrete, is quite simply the one building product that offers more sustainable development benefits than any other! Bar none! Sustainable development is sometimes defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. The purpose of this publication is to draw attention to the many sustainable advantages of concrete that make it the most responsible and conscientious of building material choices.

This special issue is divided into sections, which highlight various sustainable concrete advantages and aspects of the green movement. Each section will feature excellent current industry articles on that section's topic as well as reference web sites and other sources that can be accessed for more information.

I hope that IRMCA members will use this issue to strengthen their knowledge on the many sustainable benefits of ready mix concrete. I further hope that the many decision makers who receive this issue will use it to educate themselves about the most versatile building product in the world and I encourage any and all of you to get in touch with IRMCA (800.235.4055) or your local industry contact for more information.

Special thanks for this issue go to our newsletter editor Jennifer Bedell for her extra work on this “first-of-a-kind” magazine (for us anyway). Thanks also to our many advertisers who helped defray the costs of this issue. If response is good, we'll try it again! More information and extra copies of this issue may be attained by contacting IRMCA.



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Sustainable Advantages of Concrete

Ready mixed concrete makes significant contributions to sustainable development; concrete is in tune with the environment and when considering the cradle-to cradle impact of any building material, concrete compares very favorably:

1. **Extraction** – The ingredients in concrete are in abundant supply and easy extraction minimizes depletion of our natural resources. Most quarries are reclaimed for recreational use or returned to their natural state.
2. **Processing** – Concrete requires very low energy input for manufacture.
3. **Construction** – Ready mixed concrete is produced locally, keeping fuel requirements minimal. Ingredients are almost always produced and procured locally. There is very little waste in using concrete; it is ordered and used on an as-needed basis. Even leftover concrete is reclaimed and/or reused.
4. **Operation** – There are significant sustainable advantages to concrete buildings and pavements. Concrete's rigid design means heavy vehicles consume less fuel than when travelling over asphalt. Concrete's high thermal mass delivers year-round energy savings in buildings by reducing temperature swings. Concrete is a durable material that actually gains strength over time, extending the life of structures and delaying the need for reconstruction. Concrete walls do not require paints or sealants. Concrete does not sustain the growth of mold and it is easily cleaned. Concrete's reflectance is high, reducing lighting requirements and keeping surfaces cool.
5. **Demolition** – Concrete is relatively easy to rutilize and can be easily stored near a reclaiming operation.
6. **Recycling** – Concrete is a nearly inert material which makes it an ideal medium for recycled waste or industrial by-products such as fly ash, slag, or some aggregates. Concrete can be 100% recycled as aggregates for new concrete, for base layers, or for fill, thus reducing landfill use.

Concrete has long been known as the most versatile building product in the world. It is only relatively recently that it is being recognized for the significant and valuable role it plays in protecting and enhancing our environment.

These and other sustainable advantages of concrete will be fully discussed in the following pages of this publication.

Rendering courtesy of the National Ready Mixed Concrete Association.



The Environmental Benefits of Concrete

By Phillip Kresege, NRMCA National Resource Director

Choosing concrete as a construction material actually helps protect our natural resources and offers consumers benefits that are not available from other building materials.

As Barbara Wolcott stated in her article, "Sustainable Building: Future Friendly Pays Back," (*Permanent Buildings & Foundations Magazine*, August 1998), sustainable construction is "simply making educated choices to provide for the present, without compromising future generations' resources." In this age of environmental awareness, coupled with astronomical growth, we have become more sensitive to the concepts of sustainable building. Stemming from the "green movement" within the construction industry, sustainable building is a means of providing for the necessities of residential and commercial development, while limiting that development's negative impact on the environment to a minimum.

Concrete is a versatile product that has existed in various forms for centuries. In fact, its durability alone makes concrete a natural choice for sustainable construction. However, only recently has concrete become known for its significant role in protecting and enhancing our environment. Choosing concrete as a construction material actually helps protect our natural resources and offers consumers benefits that are not available from other building materials.

Cement, Concrete and the Environment

Many people use the terms cement and concrete interchangeably. More accurately, cement is only one of the ingredients used in the production of concrete. Portland cement is the fine powder that when mixed with water binds the sand and coarse ag-

gregate into the material we call concrete. In layman's terms, cement is to concrete as flour is to a cake. In a normal concrete mix, cement constitutes about 10-15% of the total weight.

Portland cement is one of the most widely used materials in the world today. In the United States alone, more than 120 million metric tons of Portland cement is used annually. Of that, approximately 75% is used in the manufacture of ready mixed concrete. Of all the ingredients used in concrete, cement is the only one that has any energy intensive consequence. The other materials—sand, stone or gravel and water – have very low energy requirements. Additionally, these other materials are readily available almost anywhere. Because they are locally produced, fuel requirements for handling and transportation are minimal.

That being said, it should be noted that the cement industry has taken several steps over the last few years that make their environmental record worthy of promotion. Since 1975, the U.S. cement industry has both increased its energy efficiency and reduced its greenhouse emissions by 33%. Of the four construction material manufacture processes (petroleum refining, steel production, wood production and Portland cement production), cement makes the lowest demand on U.S. energy consumption, accounting for only 0.3%. Additionally, the industry recycles 75% of its cement kiln dust and in 2001 alone recycled 53 million scrap tires, used as fuel in the cement kilns. Together, this makes concrete a very energy efficient building material.

Let's take a look at some of today's concrete applications and the role they play in sustainable development.

Recycled & Reclaimed By-Products in Concrete

For years, fly ash has been used in concrete mixes, providing a high quality product in an economical fashion. Fly ash is a by-product of coal-fired generators used to produce our electricity. In recent years, ground granulated blast-furnace slag (GGBFS), itself a by-product of the steel industry, has been used in concrete mixes as well. These supplementary cementitious materials (SCMs) exhibit cementitious

The Mix in Ready Mixed Concrete

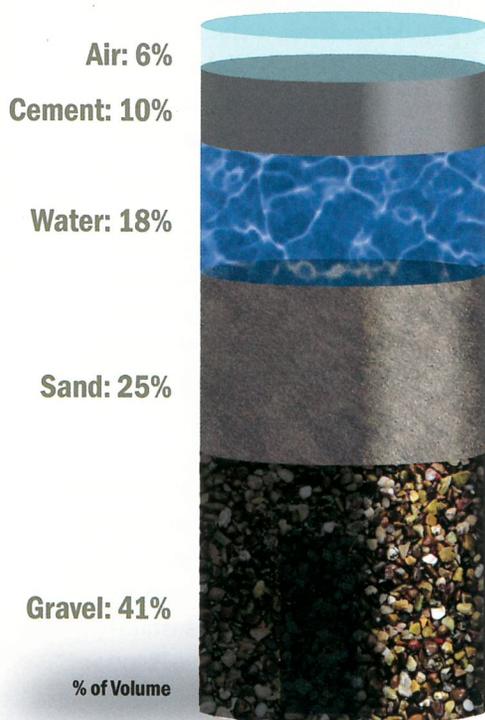


Figure 1: The primary ingredients of concrete--crushed stone or gravel, sand and water-- account for approximately 90% of the volume of the mixture and are plentiful in most locations. Cement, which accounts for most of the rest of the mixture, is usually produced and available regionally as well. Image courtesy of the National Ready Mixed Concrete Association.

properties when in the presence of Portland cement and water. The result is a high-strength, low-permeable concrete mix that will provide long lasting structures and pavements.

Use of SCMs typically reduces the amount of Portland cement required in concrete by anywhere from 10-30%. However, recently mixes have been designed utilizing much higher replacement values (up to 50% replacement in some cases). By incorporating higher percentages of these recycled materials, concrete not only becomes a more favorable material for sustainable construction, it also helps to extend the lives of our landfills.

While we often think of our natural resources as being endless, we must remember that they are anything but. In some areas, quality aggregates for concrete are already at a premium. The main focus of sustainable development is preservation of our resources for future generations. With that in mind, does it make sense to waste quality aggregates on generic fill material? Flowable fill utilizes more recycled and/or by-product material than new in its manufacture. Waste sands, foundry sands, crushed glass and fly ash, as well as other non-spec materials, can all be used in Flowable fill, sometimes in fairly large quantities. This allows the producer to save the quality materials for manufacture of concrete and reduces the need for additional aggregates. Use of recycled and reclaimed materials in flowable fill also reduces the amount of material that would normally end up in the waste stream.

Insulated Concrete Forms

Insulated Concrete Form (ICF) systems have numerous benefits to the design and construction communities. Ease of construction, reduced man hours per project and considerable acceleration of the total construction time line are just a few. Perhaps one of the biggest benefits is the energy savings realized with ICF construction. When combined with the thermal mass of concrete, an ICF wall can easily achieve insulation factors of R-30 and higher. An average reduction of 30-40% in annual heating and cooling costs is commonplace with ICF construction.

But the environmental benefits go beyond here. Utilizing ICF systems for above-grade construction can save as many as 13 trees per house, based on an average 2,000-square-foot home. Additionally, because of their minimal weight, transportation costs of ICF components are considerably less than conventional construction materials, resulting in lower consumption of fossil fuels and therefore less environmental impact. ICF systems have been identified as "Energy Star" products by the Environmental Protection Agency (EPA), qualifying ICF construction for special mortgage considerations.

Durability is certainly a key to sustainability in regard to construction. The solid construction of an ICF structure is synonymous with durability, providing security against the elements. In tests performed at the University of Texas, ICF construction was one of only three wall types that could withstand the impact of debris from a hurricane or tornado. (Not surprisingly, the other two - cast-in-place concrete and core-filled concrete masonry units - both utilized ready mixed concrete.)

Concrete and Cool Communities

As urban growth continues, densely developed areas or "heat islands" become more common. These heat islands are areas of concentrated development where due to dark roofs, loss of vegetation and dark pavements, ambient air temperature can increase by 7 to 10 degrees Fahrenheit over those of subur-

ban and rural areas. The typical reaction is to “crank up the air conditioning.” However, this only leads to an increase in energy consumption and related emissions. Studies indicate that smog increases approximately 3% for every degree of temperature.

The Urban Heat Islands Pilot Project, part of nationwide “Cool Communities” initiatives, has studied these heat islands and promotes alternative to conventional development. The best approach is to combine vegetation with lighter colored reflective building and paving materials. Concrete stands out as an obvious choice.

Because of its lighter color, concrete does not absorb heat like other, darker colored pavements. Use of concrete for local roads and parking lots can combat the increase of these heat islands. As an example, the Lawrence National Laboratory in Berkeley, CA, has estimated that approximately 40% of the Los Angeles area is covered by buildings and roads that could be made 30% more reflective during their next resurfacing. Because of its heat reflectivity, resurfacing those areas with concrete would not only lower the city’s summer temperature by as much as 9 degrees, but would also lower the need for air conditioning by 18% and reduce smog by approximately 10%. This is the equivalent of removing three to five million automobiles from the roads. In dollars, this relates to about \$90 million per year in cost benefits.

Additional cost savings can be realized with concrete pavement. Studies have shown that concrete’s rigid pavement design means heavy over-the-road trucks consume less fuel than when driving on asphalt pavement.

Being lighter in color, concrete is also more light reflective. Parking areas paved with concrete not only are cooler but also brighter and require less lighting at night. Light standards for typical parking area can be reduced by as much as a third to a half through the use of concrete pavement.

The benefits don’t stop on the ground. Concrete plays a vital role in the design and construction of green roofs, which are a combination of high albedo materials and vegetated cover with growing media taking the place of bare membrane, gravel ballast, shingles or tiles. Green roofs not only reduce heat absorption, they also can be used as part of the total stormwater management best management practice (BMP). Lightweight concrete can be used to create the sloping deck of a green roof system. Concrete structured systems are also often used to support the heavy loads caused by soil needed for the growing media.

Pervious Concrete

Speaking of stormwater management, without increased development, the percentage of pervious land space has decreased significantly. The stormwater runoff across these impervious areas has had a negative impact on the quality of our aquifer. A 1995 EPA study found that “urban runoff contrib-

utes to damage in more than 26,000 river and stream miles, and pollutes more than one million impaired lake acres.” As a result of the study, the EPA has directed states to assess their waters for runoff damages and to create watershed-based programs to repair existing damages and prevent further erosion and pollution.

Once again, the ready mixed concrete industry has the answer. Pervious concrete pavement can play a key role in any stormwater BMP. As part of an infiltration system, pervious concrete allows stormwater to seep into the ground, replicating as close as possible the pre development permeability of the site. Ground-water is recharged and water resources are preserved. Stormwater runoff is reduced and therefore runoff quality is improved. In many cases, pervious concrete pavement eliminated the need for retention ponds. Use of pervious concrete will minimize the reduction of permeability and maximize the ability to develop on smaller parcels of land, a key to low impact development (LID).

Cradle-to-Cradle Assessment

Environmental life-cycle assessment (LCA) is a procedure used to systematically evaluate the environmental impacts of a product or system. An LCA considers environmental impacts from all possible sources, including extraction of raw materials, manufacture, service life and demolition. In other words, LCA is a “cradle-to-grave” assessment of a product. More recently, a “cradle-to-cradle” approach has been desired, counting on the re-use/recycling of materials after demolition.

Concrete stacks up well in any comparison. Concrete uses fewer raw materials for manufacture than other pavement materials. With its rigidity and durability, concrete pavement has a much longer service life than flexible pavements. And at the end of its service life, concrete is 100% recyclable. The crushed can be re-used as aggregate for new concrete or utilized as a base material.

Concrete is a durable material that actually gains strength over time and conserves resources by reducing maintenance and the need for reconstruction. These are just some of the reasons that concrete should be the building material of choice for structures and pavements as we make sustainable development the accepted practice of the construction industry.

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Market Research Survey Results

Designers are increasingly turning to concrete for sustainable development because of its energy efficiency, durability and reduced maintenance requirements.

Concrete was used as a sustainable material by more than 3 out of every 4 design professionals recently surveyed about

their preference of sustainable design materials.

According to a market research study conducted by the Portland Cement Association (PCA), 77 percent of surveyed architects, designers, engineers and other design professionals said they chose concrete as their sustainable material for recent projects.

"There are few, if any, construction materials that offer concrete's wide range of sustainable and environmental benefits," said PCA President/CEO Brian McCarthy. "This survey shows the design and building community recognize that concrete can address the issues most important to their sustainable development activities."

Survey respondents ranked energy efficiency as the most important attribute when selecting a building material, followed by durability and aesthetics.

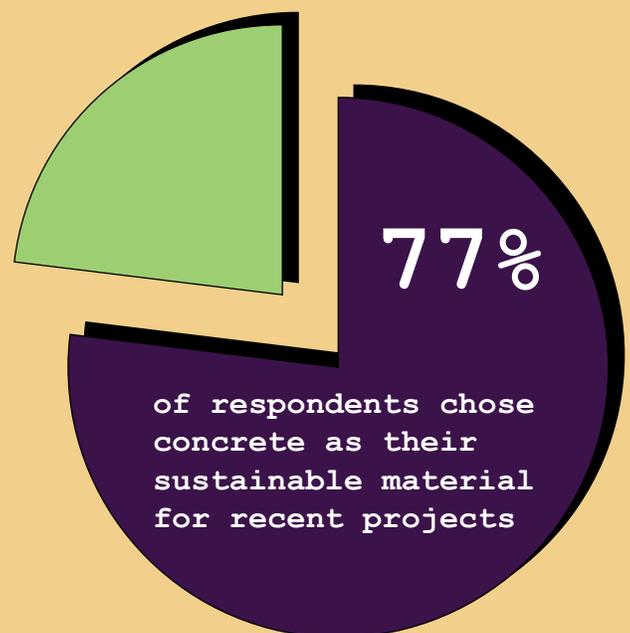
When asked which building material they preferred to meet those attributes, concrete was the most common response for energy efficiency and durability.

Concrete's role went beyond energy efficiency, however. After measuring the mean ratings of the attributes and evaluating how concrete, wood and steel were ranked against those same attributes, an index was developed to score how each material ranked, overall, as a green material. Concrete's green factor was 4.20, wood was 4.03, followed by steel with a green factor of 3.85.

"Not only are architects and designers choosing concrete, they are spreading the word on its effectiveness. 63 percent were very likely or likely to recommend using concrete for a sustainable building design, compared to 54 percent that would recommend wood and 53 percent for steel," McCarthy said.

Additionally, 42 percent agree or strongly agree that predominately cement/concrete structures provided greater sustainability than other materials.

The questionnaire, conducted in early 2008, was sent to architects, designers, engineers, and environmental planners and managers. More than 500 respondents answered a blind survey, presented in an internet survey form from a third-party Web host. Respondents were asked to answer the questions based on projects they had worked on the most during the last year.





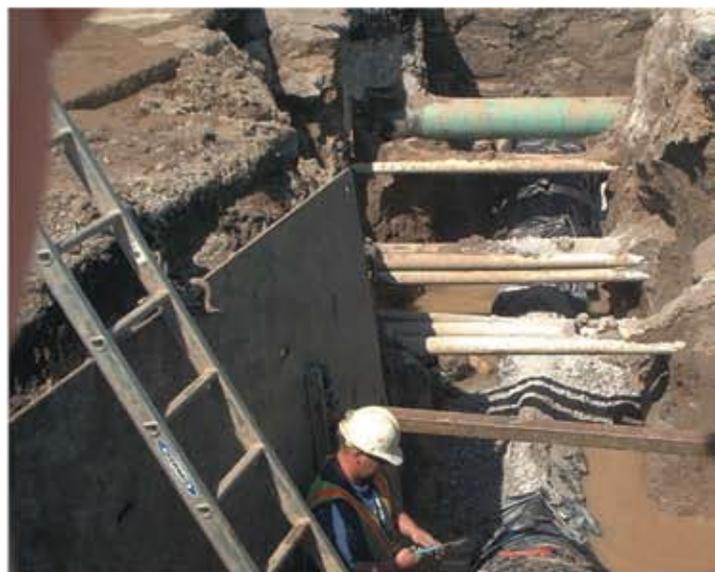
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The Concrete Advantage – Education

Perhaps nowhere is the sustainable or “green” movement more evident than in our institutions of higher learning. Every university and college in the country has adopted campus-wide strategies and curricula that are designed to encourage development of a more green campus and world. They are devoting research dollars to studying the environment. University maintenance and property employees are being instructed on ways they can contribute to the cause and students are being asked to do their part in creating more environmentally friendly campuses.

Green organizations are encouraging campuses along their way. The Association for the Advancement of Sustainability in Higher Education (AASHE) is a member organization of colleges and universities in the U.S. and Canada working to create a sustainable future. The United States Green Building Council's (USGBC) now offers Excellence in Green Building Curriculum Recognition Awards & Incentive Grants for innovative sustainability programs and then disseminates the collection of these programs to universities and educators nationwide.

Within our Illinois universities, the schools of engineering are leading the way in recognizing the need for environmental education. Many have even changed their names to include environmental recognition; e.g. the University of Illinois' Department of Civil and Environmental Engineering. Within these environmental disciplines are courses that involve designing environmental protection and remediation strategies for multiple resources. Courses include water quality and treatment; wastewater reclamation and reuse, and groundwater protection.

Concrete and its use is becoming a bigger part of the green strategies at these universities. Not only are products such as pervious concrete and concrete floors that require no covering being examined and taught, but also the university campuses themselves are recognizing the durability and, particularly, the safety advantages of using concrete for parking lots. Thousands of yards of light, reflective concrete have been placed over darker, less durable, hotter asphalt in lots at the University of Illinois and Illinois State University. Both schools laud the light surfaces that help keep their campuses more safe and say that more lots will soon be overlaid.

As the green movement gathers strength, and it will, expect concrete to play an increasingly bigger part. Concrete does provide a sustainable advantage!

This lot at Illinois State University utilizes both a concrete overlay and pervious concrete.



Higher Education Curriculum Increasingly Includes Sustainability

By Jennifer Bedell

The Higher Education Associations Sustainability Consortium (HEASC) was formed in December 2005 with a mission to support and enhance the capacity of higher education to fulfill its critical role in producing an educated and engaged citizenry and the knowledge needed for a thriving and civil society. Indeed, institutes of higher education are increasingly offering degrees or programs in sustainable development in disciplines such as sociology, architecture, engineering, ecological economics, chemistry, biology, anthropology and urban planning.

In the Department of Urban and Regional Planning at the University of Illinois Urbana-Champaign (UI-UC), Dr. Brian Deal is a proponent of this movement and is working towards UI-UC offering a sustainable degree. Deal's efforts have successfully brought sustainable design issues into the classroom, including his multi-disciplinary sustainable design studio/workshops and seminar courses; on-line courses that contribute toward a certification program in sustainable design; and professional development courses on sustainability. Deal commented that student interest in sustainable curriculum is high and his courses are consistently full. One of Deal's recent students is Eric Hansen, who graduated from UI-UC in 2008 with a Master's Degree in Urban Planning. Dedicated to sustainability both personally and professionally, Hansen says that his peers at UI-UC shared a similar commitment.

Middle Tennessee State University (MTSU), too, has adapted its Concrete Industry Management (CIM) program to include classes with an emphasis on environmental issues. Dr. Heather Brown, E.I.T., Director and Associate Professor of the CIM program, explains, "We knew that our business required knowledge in environmental safety, inspection, auditing, trends etc. We also knew that some jobs would be available that would require deeper knowledge of the subject matter, so it seemed important to provide that training as a chance for students to be more job ready and more diverse." The classes offered are:

- Introduction to Environmental Science
- Energy and the Environment
- Solar Building Design
- Energy Auditing
- Pollution Control Technology
- Air, Solids, and Noise Pollution Technology



UI-UC is nearing completion on a new College of Business building, its first sustainable building, designed to be environmentally friendly, reduce operating costs and provide a comfortable and healthy place to work. As a member of the Campus Sustainability Committee, Dr. Brian Deal is overseeing the building which is being designed by Cesar Pelli and Associates. The building is expected to earn LEED gold certification.



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One of the buildings on the UI-UC Engineering Campus.

Adrian Muela, Quality Assurance Technician for Metro Ready Mix in Nashville, is a recent graduate of the CIM program at MTSU. He has observed an increasing interest in sustainable issues among students and through his professional experience recognizes that benefit of graduating with knowledge of sustainable design and construction practices. Not only is higher education developing and offering sustainable curriculum, but employees, too, are increasingly looking for job candidates to bring this knowledge and experience.

Education for a sustainable society enables people to develop the knowledge, values and skills to participate in decisions that will improve the quality of life now without damaging the planet for the future

--The Higher Education Associations Sustainability Consortium (HEASC)

Building Green Schools

According to the U.S. Department of Energy (DOE), American schools spend roughly \$6 billion each year on energy – approximately \$110 per student per year. For most school districts, energy use is the second biggest operating expense. The department estimates schools can save 25% of this cost through better building design and energy efficiency improvements.

Twenty percent of Americans (including 50 million young people) go to school every day; more than ¼ of these students and teachers attend schools that are considered substandard to occupant health. Parents, teachers and school board officials understand better than anyone the link between child health and learning, and the fact is that children in green schools have fewer sick days and better test scores. By promoting the design and construction of green schools, we can make a tremendous impact on student health, test scores, teacher retention, school operational costs and the environment.

An average green school saves \$100,000 per year in reduced energy costs (33% less energy, 32% less water, 74% solid waste reduction) and the average life span of a school facility is

Bolingbrook High School is the first high school in Illinois to become LEED certified. School designed and built by Wight & Company; photo by George Lambros.

42 years, so the potential savings over the lifetime of the school is very significant. On a national scale, if every school went green, more than \$20 billion could be saved in energy costs over the next 10 years.

It is estimated that approximately 7% of all new building is green, and green school development is growing rapidly.

We can anticipate with certainty that architects and engineers will continue to increase the employment of sustainable design techniques as they plan for our children's educational environment.



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SAINT MONICA
SCHOOL

St. Monica Goes

Green

St. Monica School in northwest Chicago has made a decision that is changing almost everything at the school, from curriculum to the physical plant. Led by Parish Pastor Rev. Ted Schmitt, the leaders at the school have introduced an environmentally-based curriculum that will make St. Monica a true environmental academy. The classes were introduced for the 2007-2008 school year and were enthusiastically accepted by student and parents.

Not wanting to stop with just the curriculum, the principals next looked to their physical plant and decided that to be truly environmentally sound they must make improvements outside also. Architects and engineers were secured and eventually school and parish officials met with representatives of the Illinois concrete and cement industries; some important decisions were made.

The industry has volunteered to provide a section of whitetopped parking lot designed to promote reflectivity as well as longevity, and a small section of pervious concrete pavement designed to show how stormwater can be returned to the ground rather than be allowed to flow off the property. In return for the contributions, the industry will be allowed to use these lots to show and promote the sustainable features to others in the area and be allowed access to archdiocese properties and personnel through the Chicago area..

The contributed improvements from the concrete industry will be made in late summer 2008. Watch for more information in upcoming newsletters.

The concrete industry has volunteered to provide a section of whitetopped parking lot designed to promote reflectivity as well as longevity and a small section of pervious concrete pavement designed to show how stormwater can be returned to the ground rather than be allowed to flow off the property.



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- **Helps combat the "heat island" effect**
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The Concrete Advantage – Recyclability

When discussing the environmental benefits of recycling in regards to concrete, distinction must be made between actually reusing old, recycled concrete and using other recycled products in the manufacturing of concrete.

Using recycled concrete: Concrete, as well as its constituents, can be recycled thereby reducing the amount of material that is landfilled and reducing the amount of virgin materials required in construction. Most recycled concrete is used as road fill or road base. It can be used as shore protection as gabion walls or rip-rap. Recycled concrete use as aggregate in new concrete is reported in the recent RMC Research & Education Foundation report “Crushed Returned Concrete as Aggregates for New Concrete” (more information on page 24).

Use of other recycled products in concrete: Concrete is a building product that can be made with a portion of its constituent materials being recycled products, which reduces the need for virgin materials. Using recycled materials reduces the need to landfill these materials. It also reduces the environmental impacts from extracting and processing virgin materials. Fly ash, slag cement, and silica fume are industrial by-products that can be used as a partial replacement for portland cement in concrete. These supplementary cementitious materials (SCMs) are considered pre-consumer materials and their incorporation into a mix not only makes for a better product it also is very sustainable (see SCMs article on page 22.)



Supplementary Cementitious Materials Can Enhance the Sustainable Quality of Concrete

Supplementary Cementitious Materials (SCMs) are often used as carefully prescribed and partial replacement for hydraulic cement in ready mixed concrete. When combined with hydraulic cement these products can offer a variety of attributes such as increased strength, improved workability, reduced heat evolution, and enhanced resistance against deterioration due to alkali-silica reactions (ASR), sulfate attack, or harsh chemical environments. These products can also be designed for special performance applications such as soil stabilization, structural fill, road base material, and others. The most commonly used SCMs are fly ash, ground granulated blastfurnace slag, and silica fume.

Fly Ash

Fly ash is a fine, glass-like powder recovered from gases created by coal-fired electric power generation. U.S. power plants produce millions of tons of fly ash annually which used to be dumped in landfills. Fly ash has been identified as an inexpensive replacement for portland cement for use in concrete. Fly ash can improve strength, segregation, the ease of pumping, and workability of concrete and is also used as an ingredient in brick, block, paving, and structural fills. Used judiciously, fly ash can reduce the water/cement ratio needed to place a mix, rendering the concrete denser and more durable.

The use of fly ash in concrete can contribute to the promotion of sustainable growth and green building practices. Because the production of cement creates the emission of "greenhouse gases", a substitution of a prudent amount of fly ash can diminish some portion of that emission factor. Further, landfill space is also an important consideration. Every ton of coal combustion products that is used in concrete is a ton that is not deposited in a landfill, saving the same amount of space that the average American uses over 455 days.

More on coal ash can be learned at www.aaaa-usa.org.

Ground granulated blastfurnace slag (GGBS)

Ground granulated blastfurnace slag (GGBS) is a by-product from the blast-furnaces used to make iron. Slag is periodically tapped off the iron as a molten liquid, and quenched in large volumes of water resulting in a granulated material that is then dried and ground to a fine powder. Some benefits which slag imparts to concrete are better workability, lower early-age temperature rise, reduced permeability, chloride resistance, and resistance to sulfate and other chemical attacks. Its judicious use can also reduce the potential of alkali-silica reaction (ASR) in concrete.





The use of slag can be a sustainable advantage. Because slag is derived as a by-product from another industry its use is an example of industrial ecology. Instead of disposal, the slag is reused. Like fly ash, the uses of slag can reduce the amount of cement in a mix, reducing greenhouse gasses. A further green advantage of fly ash is that its use results in lighter, whiter concrete. The lighter concrete increases reflectivity and results in cooler surfaces, thus lessening the heat island effects of impervious surfaces.

More information can be found on GGBS by going to www.slagcement.org.

Silica Fume

Silica fume is the by-product from the electric-arc furnace used in the production of silicon or ferrosilicon alloys. Silica fume improves the quality, strength and durability of concrete by making the concrete much less permeable and more resistant to corrosion of the steel reinforcement. Silica fume for use in concrete is available in wet or dry forms and is normally added during concrete production. It is most often specified when goals such as high-strength and high-performance are required. More and more transportation agencies are using silica fume in their concrete for construction of new bridges or rehabilitation of existing structures. It must be noticed that placing, finishing, and curing silica-fume concrete requires special attention on the part of the concrete contractor.

Like the other SCMs, silica fume contributes to the sustainable movement. The use of high performance concrete (HPC) made with SCMs such as silica fume has increased considerably in the last two decades. HPC structures last longer and incur lower maintenance costs than conventional concrete structures, making these structures more sustainable. Furthermore, HPC uses less cement than conventional concrete, thus reducing CO2 emissions.

More can be learned about silica fume by going to www.silica-fume.org.

Concrete produced with judiciously measured amounts of SCMs can give designers and specifiers not only the desired strength but also sustainable advantages.

Eight Parameters for Optimization

Specifying the best concrete mix for a structure requires consideration of a wide variety of factors, says Ed Alsamsam, manager of PCA's buildings group. Here is a quick look at eight parameters to consider when optimizing concrete mixes using supplementary cementitious materials (SCMs):

- 1. Raw Materials** – Examine the types and quality of sand, aggregates, water, admixtures and cement.
- 2. Application** – Consider the resulting member or structure: is it a beam, column, wall or slab?
- 3. Climate** – Address regional conditions (hot or mild, humid or dry) and seasonal variations (winter or summer).
- 4. Construction Requirements** – Examine the process: will the structure be pre-stressed or post-tensioned? Will forms be stripped in 24 hours or 14 days?
- 5. Location** – Consider factors affecting the site itself, including proximity to ready-mix concrete operations or traffic patterns that can slow down trucks.
- 6. Availability of SCMs** – Find out which materials are readily available in your area; transporting SCMs over great distances will cancel out their sustainable benefit.
- 7. Quality and Grade of SCMs** – Evaluate the SCMs to ensure they will work well with other mix components.
- 8. Economics** – Consider the costs related to each of the other seven parameters to create an overall cost benefit analysis.

Information found at www.concretethinker.com.

Crushed Returned Concrete as Aggregates for New Concrete



RMC's Research and Education Foundation Final Report

In conjunction with the National Ready Mixed Concrete Association and the NRMCA Research Laboratory, the RMC Research and Education Foundation has issued its 44 page final report on using returned concrete as aggregate for new concrete. It addresses the options that ready mix producers in the USA have for using the approximately 2 to 4 million yards of concrete that return to the plants each year.

Traditionally producers have put their returned concrete through a reclaimer system for reuse or disposal; used it to pour paving around the yard or for block production; or, following strict quality procedures, added to fresh concrete. This publication addresses a fourth option - crushing the returned concrete for use as aggregate in new concrete. Not only does this option offer a remarkable cost savings, it is also very sustainable, again avoiding the landfills!

This final report is fairly technical with all aspects of this reuse very well covered and with extensive test results. Many mixtures containing reused aggregates were prepared and tested with results published in this

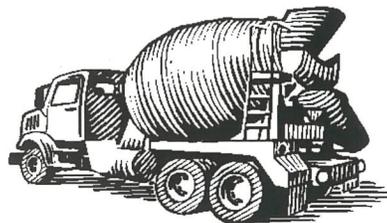
document. Aspects of concrete such as ASR, freeze-thaw durability, shrinkage and others were thoroughly tested and at the end of the document there is a section offering guidance to the ready mix producer.

This publication, along with several others, is available at the RMC website, www.RMC-Foundation.org. The document is also available through the Illinois Ready Mixed Concrete Association.

Once concrete has reached the end of its life cycle, it is 100% recyclable, used as aggregate in roadbeds or as a granular material.

--www.concreteparking.org

According to the Construction Materials Recycling Association, an estimated 125 million tons of concrete is recycled each year.



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The Concrete Advantage – Insulating Concrete Forms

Insulating concrete forms (ICFs) are rigid, interlocking plastic foam forms that are dry-stacked and hold concrete in place during curing. They remain in place afterwards to serve as thermal insulation for concrete walls. ICFs come in many different styles and sizes, but all have the advantage of being light and relatively easy to erect. ICFs are distributed through ready mixed plants, construction supply houses, and other specialty stores and many times the ICF manufacturer offers training in use and placement.

ICFs may be used for either above-grade or below-grade walls. In both cases, there are significant sustainable advantages for combining these insulating forms with ready mixed concrete. A few of the advantages are:

1. ICF walls have much higher performance R-values than wood. R-value is a measure of the flow of heat through a material; the higher the R-value, the greater the insulation. The result is lower costs for heating and cooling.
2. ICF walls restrict air infiltration, eliminating dust and allergens and creating a healthier home and living environment.
3. ICF homes are quiet and safe during inclement weather and, like all concrete structures, offer permanent strength and low maintenance.

Clearly, building with ICFs is building green. A building incorporating ICFs can earn USGBC LEED points in four of the six categories of the rating system, including Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, and Innovation and Design Process. (Learn more about LEED in the Rating Systems section beginning on page 29.)

Please refer to the other articles in this section to learn about energy savings and other sustainable features of an Insulating Concrete Form structure.



Sustainable Solutions with ICFs

By Vera Novak

On a recent trip to Hawaii, the abundant tropical vegetation brought about thoughts of sustainability. Is a house made of native woods and thatched with leaves the ideal “green” house? Perhaps, but it might not withstand the winter storms and battering of hurricanes. So durability is a factor. Nor does it provide the protection from insects and humidity. Native houses used free trade winds to cool the houses, but enclosed houses need air conditioning, which brings on the greatest environmental footprint of all – the use of energy for heating and cooling. A sustainable solution might capture the best of the old adaptations, while taking advantage of new materials for increased comfort.

Here in Illinois, our natural elements come packaged in raging winter snow storms and hot humid summer days, at the extremes. But our sustainable solutions are based on the same

factors. First, reduce energy. Second, build for durability, and third, reduce the environmental footprint of our building material. Insulating Concrete Form (ICF) construction is well suited to all three criteria.

**ICF
construction
provides
a thermal
envelope in a
straightforward
building process.**

The first task is to reduce the nation’s greatest energy hog – the heating/cooling of a building. Almost 50% of the energy consumed in the USA is used simply to maintain a comfortable temperature in our interior environment. While our Illinois climate is not well suited for natural ventilation, we can address the problem another way. Create the ideal indoor climate, and protect it as best possible from the outside influences. This is done through a continuous thermal envelope and a complete air barrier. While wood frame construction can accomplish this goal with a multi-step “band-aid” process, including the addition of an extra layer of continuous foam to eliminate thermal breaks - all this is expensive. ICF construction provides this thermal envelope

in a straightforward building process. The foam is continuous by its very nature as a forming system, and the addition of the monolithically poured concrete provides a complete airtight barrier.

The challenge for ICF builders is to think beyond the walls – to provide continuous air and thermal barriers. Windows and doors often account for 15 – 20% of the building envelope. The Energy Star label has helped to promote an excellent choice of windows, well suited to our climate. However, the most often overlooked culprit is the connection of the ICF wall to ceiling/ roof insulation. Without some provision for insulation space above the ICF wall, such as a raised heel truss, an R-40 ceiling insulation will taper down to almost no R value by the time it reaches the outside foam panel of the ICF. This gap around the perimeter of a building often accounts for the biggest loss of energy efficiency in buildings.

Our second consideration for sustainability is durability. Durability refers not only both to the ability of the structure to withstand tornadoes and floods, but also to resist the more constant forces of nature – such as mold and termites. Who can forget the pictures of new homes, whose walls had rotted away in just a season from a bad combination of building materials. No such story will occur with ICFs. Mold happens in a combined environment of the right amount of moisture, food and temperature which does not exist in ICFs. Neither EPS foam nor concrete will rot or mold.

Our second challenge to ICF builders is to acknowledge the change created in the interior environment due to the airtight ICF envelope, and pursue an HVAC solution which is

right-sized for the building. An appropriately sized air conditioner will run for long stretches of time, providing the function of dehumidification. ICF builders should seek out qualified HVAC contractors to be part of their team. Energy Raters can also quantify the equipment sizing and often provide references to HVAC solutions. (www.resnet.us).

Our third element of sustainability relates to the environmental footprint of the building material, often referred to as the “embodied energy” of a material. This refers to all the environmental impacts of a product from the cradle to grave of the material. Our concrete aggregate is a local product, with local quarries reducing the cost of transportation. Portland cement, while linked to a sizeable impact in CO2, has seen significant emissions improvements industry wide. ICFs also offer an excellent curing environment for use of high fly-ash mix, not only improving the mix handling, but also the long term strength.

But it all comes back to energy efficiency. The less energy used in the heating/cooling of a building, the lower the environmental footprint, or life cycle assessment (LCA) of a building. Insulating Concrete Form construction is time tested for a favorable life-time performance - - a great sustainable solution.

Vera Novak is Technical Services Manager for ICFA and can be reached at vnovak@forms.org.

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ICF Energy Savings

By Jennifer Bedell

According to the Insulated Concrete Forms Association (ICFA) web site, www.forms.org, homes with ICF exterior walls require an estimated 44% less energy to heat and 32% less energy to cool (see Figures 1 and 2) than comparable frame houses because the concrete walls provide greater insulation, tighter construction and the thermal mass of concrete naturally conserves heating and cooling energy. With ICF walls, not only is money saved through reduced fuel bills, but also during construction since smaller heating and cooling equipment are needed.

The thermal mass minimizes inside temperature fluctuation as the outside temperature changes. The walls store energy and release it to heat or cool the house, contributing about 6% of the needed energy to the house for free. The insulating value of ICF walls using polystyrene foam is R-17 to R-26, whereas the insulating value of wood walls is R-9 to R-15. ICF homes average about 1/2 as much infiltration as frame homes.

Further energy efficiency can be achieved in ICF homes by:

- installing high performance windows
- installing a geothermal heating and cooling system
- installing a solar water heater
- orienting the house to maximize energy efficiency
- using effective insulation
- sealing holes and cracks in the home's envelope and in heating and cooling duct systems
- installing efficient heating and cooling equipment
- installing efficient products (i.e., light bulbs, light fixtures, ventilation fans, appliances, etc.)

Graph data courtesy of Portland Cement Company.

Moisture, which can undermine other building materials through rust or rot, has no weakening effect on concrete. Neither termites nor mold take any toll on concrete either. In fact, concrete continues to strengthen over time, which is why concrete structures built thousands of years ago are still intact, such as the Roman aqueducts, Coliseum and Pantheon.

www.greenconcrete.info

Energy Efficient Mortgage (EEM)

ICF homes are more affordable because an increasing number of lenders offer discounted financing for energy efficient homes. Home buyers who choose energy-efficient homes can spend more on their mortgage because they will likely spend less on their energy costs. EEMs allow borrowers to qualify for a larger mortgage as a result of the energy savings.

Figure 1: Estimated annual heating savings

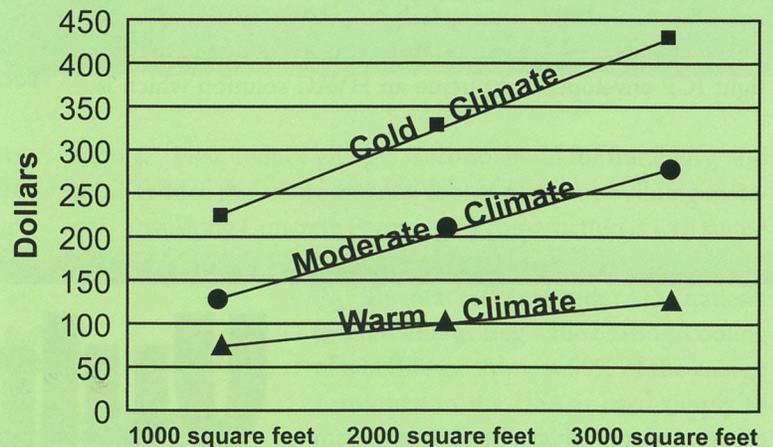
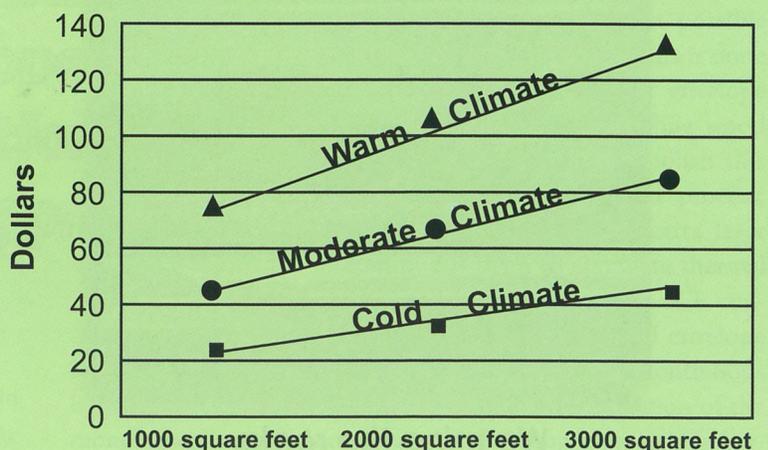


Figure 2: Estimated annual cooling savings



The Concrete Advantage - Rating Systems

The United States Green Building Council (USGBC) is a non-governmentally-involved 501 (c) (3) non-profit community of more than 3000 organizations working together to make green buildings accessible to everyone within one generation. This powerful organization urges “green construction” at all levels and lobbies hard on behalf of their goal. In an effort to quantify their building goals, the USGBC has created the Leadership in Energy and Environmental Design (LEED™) green building rating system. Below is a list of the many points concrete can earn toward certification.

LEED™ v2.2 Project Checklist: Concrete can help a project earn 19-28 LEED™ points

Credit Categories

Points

Sustainable Sites

Credit 3	Brownfield Redevelopment	1
Credit 5.1	Site Development, Protect or Restore Habitat	1
Credit 5.2	Site Development, Maximize Open Space	1
Credit 6.1	Stormwater Design, Quantity Control	1
Credit 6.2	Stormwater Design, Quality Control	1
Credit 7.1	Heat Island, Non-roof	1
Credit 7.2	Heat Island, Roof	1

Energy and Atmosphere

Prerequisite 2	Maximize Energy Performance	Required
Credit 1	Optimize Energy Performance	1 - 10

Materials and Resources

Credit 1.1	Building Reuse, Maintain 75% of Existing Walls, Floors and Roof	1
Credit 1.2	Building reuse, Maintain 95% of Existing walls, Floors and Roof	1
Credit 2.1	Construction Waste Management, Divert 50%	1
Credit 2.2	Construction Waste Management, Divert 75%	1
Credit 4.1	Recycled Content, 10% (post-consumer plus ½ pre-consumer)	1
Credit 4.2	Recycled Content, 20% (post-consumer plus ½ pre-consumer)	1
Credit 5.1	Regional Materials, 10%	1
Credit 5.2	Regional Materials, 20%	1

Innovation and Design Process

Credit 1.1	Durability	1
Credit 1.2	Concrete walls and ceiling with no coating	1
Credit 1.3-1.4	Apply for other credits demonstrating exceptional performance	2+
Credit 2	LEED™ Accredited Professional	1

Project Totals

19-28

Information as found at www.greengreenconcrete.info.

LEED™ and Other U.S. Rating Systems

At least 26 points are required for LEED certification. Silver, gold, and platinum levels are also available.

Credit Category	Points Available
Sustainable Sites	14
Water Efficiency	5
Energy and Atmosphere	17
Materials and Resources	13
Indoor Environmental Quality	15
TOTAL CORE POINTS	64

Note: an additional 5 points are available for Innovation and Design Process

LEED Certification Levels

Certified	26 - 32 Points
Silver	33 - 38 Points
Gold	39 - 51 Points
Platinum	52 - 69 Points

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ is a third party certification program and a national benchmark for green building. LEED promotes a whole-building approach to sustainability by recognizing performance in five areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

In the past, designing and building to LEED certified levels (or to other standards such as Green Globes) was voluntary. The reward was a plaque, peer recognition, an enhanced reputation for

Allan Anderson, market manager for Buzzi Unicem USA and above grade champion for ICF in IL for GLCPA, writes that builders are not only increasingly incorporating ICFs in a variety of applications but also are starting to take advantage of several programs for which ICF construction qualifies.

One of these programs is Energy Star, a label which identifies qualified homes according to guidelines set by the US Environmental Protection Agency. Energy efficient features of an Energy Star home include:

- Effective insulation
- High performance windows
- Tight construction and ducts
- Efficient heating and cooling equipment
- Efficient products (lighting, appliances, etc)
- Third party verification

excellence and the good feeling of building an environmentally sound building. Now, however, organizations and municipalities, such as the GSA and the City of Chicago, are mandating LEED (or other) certification of their new buildings and renovations.

Other US sustainable rating systems include:

- Green Globes, www.greenglobes.com
- Sustainable Projects Rating Tool, www.cecer.army.mil/sustDesign/fSPIRIT-info.cfm
- Energy Star, www.energystar.gov/index
- National Green Building Standards, www.nahbrc.org

Most ready mixed plants are within 100 miles of the project site. Most precast concrete and masonry plants are within 200 miles of the project site.

--www.concretethinker.com

A new project in Chicago's West Garfield Park is helping to revitalize the neighborhood, bringing much-needed daycare, employment assistance, computer training, retail, financial services and office space- and uniting it with a recently renovated "El" station linking the community to the rest of the city. Dedicated May 19, the Bethel Center provides the neighborhood with an anchor around which a more sustainable community can be crafted. Concrete is a core component of the structure, which achieved Leadership in Energy and Environmental Design (LEED) Gold certification.

TRANSIT-ORIENTED DEVELOPMENT IN ACTION

The project was created by Bethel New Life, Inc., a community-directed non-profit organization that grew out of Bethel Lutheran Church in the 1970s, and has since been an innovator and motivator in the west side neighborhood. Planning began almost 10 years ago, when the Chicago Transit Authority threatened to shut down the Green line serving the area. Protests led the city to save the line, and Bethel New Life started planning the building- which fit well with the organization's sustainable goals.

Aligning the project with the El station was key, says Mary Nelson, CEO of Bethel New Life. In this community, only about 35 percent of residents have cars, so public transit is a way of life for most. "We see this building, at this transit stop, as an anchor," says Nelson. "We've built at least 50 new housing units within walking distance as a part of transit-oriented development. This new building is just the first step, a wonderful stepping stone to revitalizing the area."

In Chicago Concrete Creates New Opportunities

By Jennifer G. Prokopy

FROM FOUNDATION TO ROOF, CONCRETE BRINGS BIG BENEFITS

Farr Associates of Chicago planned and designed the project. The firm practice "socially and environmentally responsible architecture, planning, and preservation," and its principals are actively involved in numerous planning committees to promote this mission.

Bethel Center, says principal Kevin Pierce, goes "beyond the transit-oriented aspect of environmentalism," offering services rooted in environmental justice and social equity. Nelson says it shows how "a transit stop can be a major asset in a community, providing economic viability."

Designed on a tight site, the two-story building has a third-story portion that acts as a lobby for the bridge from the El platform. A steel structure forms the building's shape, but the rest of the structure is all about concrete.

The building is constructed on a brownfield site, anchored by a foundation that incorporates 25 percent fly ash replacement in the slab and footings.

The walls are manufactured using the Solarcrete system. Seven-inch-thick slabs of foam are wrapped with a reinforcing steel cage; the pre-manufactured slabs are shipped to the worksite and attached to the building frame. The slabs are then covered with shotcrete (specified at 4,000 psi) in a layer about 2 inches thick, on either side of the wall, and screeded off to create a smooth, level surface.

Because the shotcrete and steel frame will experience independent thermal movement, the shotcrete is separated from the frame. The two concrete sides of each Solarcrete wall are joined with nylon ties, in a perpendicular two-foot grid across the face of the wall, and the units are finished with a layer of synthetic stucco. The resulting walls offer a thermal value of R-25.

Bethel Center also uses a precast concrete plank floor and roof system. Utility conduit was installed before the planks were finished off with a two-inch topping slab, hiding utilities and keeping the ceilings uncluttered. "The undersides of the planks are the finished ceilings-painted a clean white to get great reflective daylighting," says Pierce.

"A steel structure forms the building's shape, but the rest of the structure is all about concrete."

“Mayor Daley is a proponent of green roofs, so it was natural to install one at Bethel Center.”

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The long plank design that includes holes for 4-foot by 10-foot skylight wells, one per 20-foot bay. This easy, inexpensive approach means every top-floor space enjoys daylighting, and helps reduce the energy used by light fixtures.

SAFETY, COMFORT AND ENERGY

Chicago Mayor Richard Daley is a proponent of green roofs, so it was natural to install one at Bethel Center. The presence of daycare required a class 1 fire rating, but a concrete roof eliminated the need for a costly sprinkler system and also met the city's strength criteria (100 pounds per square foot) for green roofs.

When it comes to comfort, Bethel Center has it, says Pierce. The thermal mass of concrete helps keep temperatures even and consistent and blocks noise from

busy adjacent Pulaski Road and the El train. Stairs in the building are pan filled with concrete.

The structure will provide its inhabitants with a quiet setting for work and play, one that stays cool in the summer and warm in the winter. In fact, energy modeling (performed according to the Chicago Energy Conservation Code's total building energy model) shows that the Center exceeds requirements by 50 percent, with projected annual energy savings of \$12,000.

For more information on Bethel Center, visit www.bethelnewlife.org. This article was first published in the September 2005 Concrete brochure and is reprinted here with the permission of the Portland Cement Association.



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Winter 2008

ICF Park Pavilion

By Jennifer Bedell

ICF wall construction will help earn LEED Platinum Certification for this feature of the Edwin Watts Southwind Park in Springfield, Illinois

The concrete in the ICF provides thermal mass helping to stabilize the exterior temperature swings contributing to a more energy efficient building envelope.



Architectural rendering of Erin's Pavilion courtesy of The Walton Group.

On July 16, the Springfield Park District and the Springfield Parks Foundation broke ground on The Edwin Watts Southwind Park at South Second Street and Southwind Road, and it is serving as a national model for both accessibility and sustainability.

The park district and foundation envision “an all people park, serving cognitive, emotional, physical and social needs in a diverse and fun setting without physical and social barriers.” Park features include a 2.25 mile pathway, a 4.5 acre lake, a waltzing waters fountain, an outdoor amphitheater, sensory gardens, an 8-acre great lawn and Erin's Pavilion, a 7,000 square foot recreation center, all completely accessible for individuals with all levels of disabilities.

Erin's Pavilion was designed by Walton & Associates Architects, P.C. of The Walton Group in Springfield to earn LEED platinum certification. One of the design architects working on this project, David McDow, AIA and LEED accredited professional, said, “Insulated Concrete Forms (ICF) wall construction will be used for Erin's Pavilion. The concrete in the ICF provides thermal mass helping to stabilize the exterior temperature swings contributing to a more energy efficient building envelope. In addition, since the concrete in the ICF is monolithic, a very tight building envelope is created, reducing air infiltration.” Concrete is also helping earn certification points because of a specified mix design that includes

fly ash and the fact that most of the concrete components are available within a 500 mile radius of the project site. Additionally, the use of concrete paving will reduce the heat island effect and pervious concrete will be part of a storm management system in some areas.

“Sustainable efforts being planned for the park go beyond the building aspects,” says Diane Mathis, who oversees the marketing, coordination and development of the park for the Springfield Park District, “including solar powered signage, an irrigation system for the great lawn that recycles water from the lake, bio swales, wetlands and a wind turbine.”

This project gained momentum when the descendants of Edwin Watts donated the 80-acre farm that he had purchased in 1901 to the Springfield Park District to develop a new park. The park is projected to be completed in June 2009 at a cost of \$15 million. To date more than \$10.5 million has been raised:

- \$7 million secured by the Springfield Park District through bond, taxes and matching state fund grant
- \$700,000 through fund-raising events by local community individuals and business donations
- \$2 million of in-kind services in the form of time and materials from local businesses
- \$922,500 in grants



Uptown Renewal Plan Includes Ordinance Requiring Green Building Practices

By Jennifer Bedell

The government's leadership through programs such as LEED is encouraging more sustainable development.

In March 2002, the Town of Normal Council adopted a new ordinance (Municipal Code, Chapter 15, Division 17, Sections 15.17-1 through 15.17-15) for its uptown central business district, requiring all new construction with more than 7500 square feet at the ground level to comply with at least certification level USGBC-LEED design standards. Furthermore, renovation of existing structures may not violate any of the design standards established for new construction.

A Design Review Commission was established to monitor uptown construction and property owners must obtain a Certificate of Compliance from the commission before proceeding with rehabilitation, alteration or new construction.

Pam Reece, Assistant City Manager for Normal, commented the Town of Normal developed the new policy as part of the Uptown Renewal Plan and was proud to set an example by completing the first project under the renewal plan, the \$5 million Children's Discovery Museum. The construction project broke ground in January 2004 and the new museum opened its doors later that year. The museum exceeded expectations when it was awarded LEED Silver Certification. According to Mercy Davison, Normal Town Planner, the Children's Discovery Museum was the first LEED project in Illinois outside of Chicago and it has the distinction of being the first children's museum in the country to be LEED certified.

The museum was designed by Francois Associates Architects of Bloomington, Illinois. Regarding the advantages of concrete as a green building material, Russel Francois, AIA, owner of Francois Associates Architects, says, "Concrete can do so many things for us. It is an efficient material, has a unique fluid quality, is low bearing and has a long history. There is little or no waste; it is recyclable." Francois goes on to comment about green building, saying that the government's leadership through programs such as LEED is encouraging more sustainable development.

The first private project to be completed since the implementation of the Uptown Renewal Plan is Bank of Illinois. Although still in the application process, this project is expected to earn LEED Silver Certification. John Bishop, AIA, LEED accredited professional and senior project architect for Farnsworth Group in Bloomington cites the accountability factor as a benefit of rating systems and green building policies.



Above is the completed Children's Discovery Museum in Uptown Normal, IL. The building was awarded LEED Silver Certification and was the first new construction after the town council put in place a new policy requiring sustainable building practices. Photo Courtesy of the Children's Discovery Museum.



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Ready Mixed Concrete LEED Reference Guide

NRMCA worked with the RMC Research and Education Foundation to develop the Ready Mixed Concrete LEED Reference Guide. LEED, which stands for Leadership in Energy and Environmental Design, is the most widely adopted green building rating standard. It's used by building designers to implement green building practices to minimize environmental impact of construction. Since concrete is used in nearly every building built today, it can play a key role in establishing credits towards LEED certification. However, since the LEED rating system is complicated, the Ready Mixed Concrete LEED Reference Guide was developed to help producers and designers understand how concrete can be used to meet LEED requirements. The document is available for download at www.nrmca.org and www.rmc-foundation.org.

New Engineering Guide to LEED

Liv Haselbach, faculty member in the Civil and Environmental Engineering Department at the University of South Carolina, has authored *The Engineering Guide to LEED – New Construction: Sustainable Construction for Engineers - 2008*. This step-by-step guide outlines the accreditation process for the U.S. Green Building Council's LEED-New Construction rating system. Questions, exercises and discussions will help guide your office or job site through the necessary steps. The book also features information on sites, water efficiency, energy, atmosphere, air quality and other elements as they relate to sustainability. Check local or online bookstores to purchase a copy.

NRMCA Gains Green Building Education Provider Status

NRMCA has been approved as a U.S. Green Building Council (USGBC) Education Provider and launched its first approved course titled Green Building with Concrete on Tuesday, July 15 in Silver Springs, MD. The USGBC Education Provider Program presents high-quality professional development courses to further enrich the knowledge and understanding of green building theory, techniques and trends for building professionals.

NRMCA's new Green Building with Concrete course received the USGBC Education Program status after a comprehensive review of the course materials, course content and instructors. The course has been added to USGBC's growing catalog of courses and is listed on the USGBC web site – www.usgbc.org.

Stormwater Management

As land is developed, the impervious surfaces that are created increase the amount of runoff during rainfall events, disrupting the natural hydrologic cycle. Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like parking lots, driveways, sidewalks, and streets prevent stormwater runoff from naturally soaking into the ground. Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the water bodies we use for swimming, fishing and providing drinking water. Without stormwater controls, the increased runoff can erode stream channels, increase pollutant loadings, cause downstream flooding, and prevent groundwater recharge. Published on December 8, 1999, the *EPA Stormwater Phase II Rule*, in general, requires operators of small Municipal Separate Storm Sewer Systems (MS4s) in urbanized areas to develop and implement a stormwater management program that addresses specific minimum control measures. Among the controls, the Phase II program requires every regulated city or county to develop a comprehensive program to reduce the discharge of pollutants and protect water quality from stormwater discharge. Any development or redevelopment in these areas that disturbs one acre or more must comply with phase II regulations. The EPA offers an extensive list of best management practices (BMP) to help owners within these regulated areas to control runoff. Porous pavements have been named a BMP and have been approved to help owners comply with Storm Water Phase II regulations. One such porous pavement is pervious concrete. Pervious concrete, in conjunction with a storage layer below, forms a system that can reduce the need for large retention ponds because the pavement acts as a retention area. Besides retention, the system has many more sustainable benefits that are addressed in articles throughout this section.

The rate of rain infiltration through pervious concrete paving is 300 inches per hour.



Photo by Jennifer Bedell

According to the American Concrete Institute Report ACI 522R-06, pervious concrete is used to generally describe a zero-slump, open-graded material consisting of portland cement, coarse aggregate, little or no fine aggregate, admixtures and water. As the use of pervious has increased, specifiers are substituting measured quantities of industrial by-products with cementitious qualities for a percentage of the portland cement. The hardened product contains a void structure that ranges from 18 to 35% allowing stormwater to flow through the pavement into a detainage system and eventually returning that water to the ground. Conventional, impervious pavement allows stormwater to run off possibly polluting surface groundwater supplies and leading to potential downstream flooding. Pervious concrete is used in parking, floors, base courses, seawalls, roads, exercise paths and more. It is used to control stormwater pollution at the source as well as runoff; its detainage system can eliminate the need for space-hogging detention ponds; it can eliminate or reduce the size of sewer systems; it reduces glare, noise and hydroplaning on wet pavements; and it saves tree and plant root systems. Use of pervious concrete in the United States began in the south and successful applications have moved into the freeze-thaw areas of the country as well. Ecological conscious developers, architects and engineers are specifying pervious concrete as they strive to be green. As the interest in pervious continues to rise, organizations such as the National Ready Mixed Concrete Association, The Portland Cement Association, and others including state and local groups like the Illinois Ready Mixed Concrete Association (IRMCA) are actively promoting pervious concrete and training placement contractors. Please contact IRMCA for more information @ 800.235.4055.

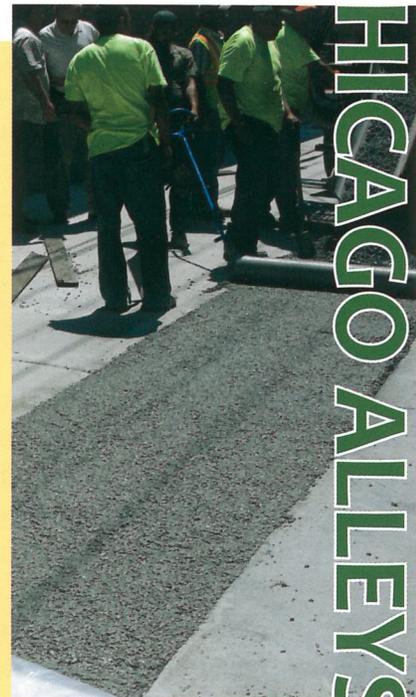
What is Pervious Concrete

“With more miles of alleyways than any other city in the world, Chicago has a unique network of infrastructure integrated into the very fabric of our city. Recognizing this advantage, we have established new alley designs that help conserve our resources and improve our environment,” said Richard M. Daley.

Using this direction from the Mayor as a guide, the Chicago Department of Transportation embarked on what became known as the Chicago Green Alley Initiative, a plan to resurface the city’s roughly 2,000 miles of alleys (that’s the size of five midsize airports) with sustainable permeable pavement. Below are the environmental benefits CDOT seeks to gain through the program:

- **Stormwater Management:** Imagine if all the alleys in Chicago were green alleys. Up to 80% of the rainwater falling on these surfaces throughout the year could pass through permeable paving back into the earth, thereby reducing the localized flooding, recharging groundwater and saving taxpayer money that would otherwise be spent treating stormwater.
- **Heat Reduction:** Imagine if all the alleys had a light, reflective surface (high albedo) that reflected heat energy, staying cool on hot days and thereby reducing the “urban heat island effect”, a condition where dense urban areas become several degrees warmer due to the density of buildings and amount of heat-absorbing paved areas.
- **Material Recycling:** Imagine if all of the alleys were constructed with recycled materials, thereby reducing the amount of construction and industrial waste hauled to landfills and reducing the burden on our natural resources.
- **Energy Conservation and Glare Reduction:** Imagine if the thousands of light fixtures that provide a safe environment in the alleys were energy efficient and reduced glare and light pollution to the point where you could see the stars at night.

Describing the anticipated results, Brian Steele, spokesperson for CDOT says, “Not only is it [the pervious system] capturing water and preventing it from flooding streams and yards and basements, but also it’s permeating into the ground in hopes of recharging the underground water table.” The City of Chicago Alley initiative Handbook can be seen and downloaded by accessing <http://egov.cityofchicago.org>.



CHICAGO ALLEYS

“Sustainable development.” “Green Building.” “Environmentally friendly materials.” These terms no longer are part of the vernacular previously reserved only for those with an environmental conscience.

Today, individuals, companies and governments worldwide are demanding that energy and the environmental impacts of construction projects be considered long before ground is broken. This dramatic change in thinking has given rise to “green” building rating systems such as the popular U.S. Green

Sustainable Development: The Wave of the Future

By: Jennifer LeFevre RMC Research & Education Foundation Program Director

Building Council’s (US-GBC) Leadership in Energy and Environmental Design (LEED) program and others.

Efforts to thwart global warming and decrease our overall carbon footprint are discussed daily in popular media and the issue will likely be a main topic of discussion in this year’s presidential election. Everyone

now claims to want to be a part of the solution. Concrete, however, has always been an environmentally friendly building material and part of the solution, even before the problem was widely recognized.

Concepts that fall within the sustainable framework include decreasing the carbon footprint, increasing energy efficiency, the promotion and use of recycled materials and further development of environmentally sound construction materials and practices. The RMC Research & Education Foundation

has made a significant contribution to forwarding each one of these concepts, with tremendous results and response to these projects.

One area of pavement construction that has seen a particularly high explosion of interest on the part of builders, architects, designers, government officials and others is pervious concrete. With its stellar Stormwater management qualities, its positive environmental impact and potential safety benefits, it’s not surprising that its popularity has soared in recent years. This surge in interest in pervious concrete has also likely been fueled by several research projects

One area of pavement construction that has seen a particularly high explosion of interest on the part of builders, architects, designers, government officials and others is pervious concrete.

funded and released by the RMC Research & Education Foundation over the last year and a half.

In early 2007, the foundation released two projects developed

Pervious concrete with detainage being placed and cured at the edge or a newly whitetopped parking lot.



by the Stormwater Management Academy at the University of Central Florida: "Construction and Maintenance Assessment of Pervious Concrete Pavements" and "Hydraulic Performance Assessment of Pervious Concrete Pavements for Stormwater Management Credit." The reports, funded in cooperation with Rinker Materials and the Florida DOT, support the increased use of pervious concrete by demonstrating its effectiveness in stormwater management practices and through outlining proper maintenance techniques. Both studies also underscore the importance of proper placement and mix design.

The U.S. Senate's Environment and Public Works Committee and the Environmental Protection Agency (EPA) have expressed deep concern over the environmental impacts of various pavements. In an effort to address some of these concerns, the Villanova Urban Stormwater Partnership at Villanova University has undertaken a side-by-side comparison of pervious concrete and porous asphalt. Funded by the RMC Research & Education Foundation, Villanova University, the EPA and Prince George's Country, MD, the study is examining the differences between pervious concrete and porous asphalt with regard to durability, maintenance requirements, the ability to transmit or filter key contaminants such as hydrocarbons and the ability to mitigate heat-island effects. Given the intense government interest in the environmental impacts of pavement, a key component of this project includes the impact these two pavements have on water quality.

It is not surprising, given the successful use of pervious concrete pavement in parking areas and sidewalks, that the construction and design communities would be interested in expanding its use—along with its environmental benefits—to streets, local roads and even highways in the future. The RMC Research & Education Foundation is working with The CP Tech Center at Iowa State University to study just such a possibility. This pervious concrete mix design for wearing-course applications study will examine the development of concrete mix designs that have adequate strength and durability for wearing-course pavements.

Additionally, the pavement would have surface characteristics that reduce noise and enhance skid resistance while also providing adequate surfaces and structure. The development of pervious concrete mixes for use in highways, street and local road applications will examine their sustainability for this use as well as their long-term behavior. The tremendous interest in bringing pervious concrete to roadway use is evidenced by the study's co-funding on the part of the Federal Highway Administration, the American Concrete Pavement Association and the Pooled Resources Fund of several state Departments of Transportation.

One explanation given for the hesitation to embrace the use of pervious concrete in Northern climates was the uncertainty of its performance in freeze-thaw conditions. In order to assuage

those concerns, the RMC Research & Education Foundation funded a long-term field performance study of pervious concrete's performance in harsh weather conditions. The study, "Portland Cement Pervious Pavement: Field Performance Investigation on Parking Lot and Roadway Pavements," validated the belief that pervious concrete could perform well in freeze-thaw environments, with little maintenance required. The finding of the study will allow Northern states to use pervious concrete with confidence. Builders in cold climates are particularly excited about the prospect of being able to use pervious concrete, not only because of all of its environmental benefits, but also because of the safety benefits it offers. On impervious surfaces, when snow melts and refreezes, the resulting ice poses a danger to pedestrians. Pervious concrete allows melting snow to run through it so there is no ice when temperatures again fall below freezing.

A concrete design and its mix could perfectly meet specifications, but if the concrete isn't placed correctly, subsequent problems are a black eye on the entire industry. Pervious concrete pavement, like other concrete projects, must be placed correctly to maximize performance. However, not as many contractors are familiar with pervious concrete as they may be with the placement of other concrete mixes since it is a newer application. For this reason, the RMC Research & Education Foundation funded the development of a "Pervious Concrete Contractor Certification Craftsman Text" to complement a certification offered by the National Ready Mixed Concrete Association. Ensuring the proper training of concrete contractors who place pervious concrete was a high priority for this educational tool and that it would provide an opportunity for contractors to better acquaint themselves with the nuances of pervious concrete and its proper placement.

Never before have the concepts of sustainable development and green building been more important than they are today. In looking

toward the future, the concrete industry will play an extremely important role as energy and environmental considerations become a priority in the design, building and construction communities. The RMC Research & Education Foundation, as part of its charter to support projects that will benefit the concrete industry and the citizens of the United States, will continue in its commitment to seek and support projects that promote sustainable development. Of course, it's easier to do that when you start with a superior material like concrete. But even the best can become better!

Many of the reports and final studies referenced in this article are available for download site at www.rmc-foundation.org.

In looking toward the future, the concrete industry will play an extremely important role as energy and environmental considerations become a priority in the design, building and construction communities.

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National Forum Convenes in Denver

Concrete sustainability experts from around the country convened in Denver, CO, in May for the National Ready Mixed Concrete Association's Concrete Technology Forum, *Focus on Sustainable Development*. There were 57 presentations on the topics of general sustainability, recycled concrete, pervious concrete and mix optimization. The speakers were from academia as well as industry representatives and many of the presentations came from papers that have been written for ACI, ASTM, etc.

Michael Deane of Turner Construction described how his company feels it can sell a job based on sustainable building. Also presented were: a comparison of LEED and GBI Green Globes

rating systems; urban heat islands by Vance Pool and Liv Haselbach; and "bendable" concrete.

In the area of pervious concrete there were presentations concerning:

- hydrological design
- how important is strength
- testing durability
- an update on ASTM C 09.49 – testing methods for pervious.
- Dr. John Kevern and others reviewed successes in Iowa, freeze thaw testing, and using a pervious overlay on high use pavement.
- tests for sedimentation in pervious and oils in pervious
- testing for compaction.

The recycle presentations centered on both use of industrial by-products and the recycling of

concrete itself. They also examined reusing plastic concrete and wash water and the use of crushed concrete as new concrete aggregate.

Mix optimization presentations and papers centered on:

- high performance concrete
- the use of fly ash, slag and silica fume
- the use of limestone,
- green cements
- the use of alternate fuels in the production of portland cement.

Readers can access the entire list of speakers and topics by going to www.concretetechnologyforum.org. The Illinois Ready Mixed Concrete Association has "on file" all the complete PowerPoint presentations and accompanying technical papers. If you are interested in obtaining a particular presentation or paper, feel free to contact IRMCA @ 800.235.4055.



Side-by-Side Comparison of Pervious Concrete & Porous Asphalt

This study, being carried out by Villanova University's Villanova Urban Stormwater Partnership, will examine the differences between pervious concrete and porous asphalt with regard to durability, maintenance requirements, the ability to transmit or filter key contaminants such as hydrocarbons and the ability to mitigate heat island effects. There has been a great deal of interest, particularly on the part of the United States Congress and Environmental Protection Agency (EPA), to research the environmental impact of various pavements, and a key component of this research will include the impact these two pavements have on water quality. Since maintenance requirements will be studied as well, the researchers will also include recommendations for keeping the pavements functional.

Pervious concrete.

A Sampling of Publications Relating to Pervious Concrete

Note: All of these publications are available from the authoring organization or from the Illinois Ready Mixed Concrete Association @ 800.235.4055.

Ready Mix Concrete Industry LEED Reference Guide	NRMCA	This guide explains the LEED rating system and discusses in detail how the use of concrete can help gain LEED points
Specifiers Guide (Pervious Concrete with Detainage)	IRMCA	This document offers owners, architects, engineers and others a guide for specifying a pervious system
Pervious Concrete – When it Rains it Drains	NRMCA	A full color, 4 page brochure introducing pervious concrete
Pervious Concrete in Severe Exposures	CP Tech Center at Iowa State University	A summary of work being done at Iowa State that focuses on the durability of PCPC subjected to freezing-and-thawing (FT) cycles.
Oil Retention and Microbial Ecology in Porous Pavement Structures	Coventry University	A paper on oil retention and breakdown in pervious concrete
Pervious Concrete Research Compilation	NRMCA	A compressive listing and categorization of studies into pervious concrete
Portland Cement Pervious Concrete Pavement: Field Performance Investigation on Parking Lot and Roadway Pavements	RMC Research & Education Foundation	Documents observations and testing of pervious in freeze thaw regions
NRMCA Freeze Thaw Document	NRMCA	Thorough discussion of the use of pervious in freeze thaw environments
NRMCA Model Stormwater Ordinance including Pervious Pavement Systems	NRMCA	A model ordinance that can be adopted by municipalities
Hydrologic Design of Pervious Concrete	PCA	A design guide for engineers and permitting agencies to help in developing acceptance of pervious concrete
Procedure for Determining Need for Maintenance of Pervious Concrete Via Infiltration Rate	PCA	
LEED Rating System	USGBC	
Oil Retention and Microbial Ecology in Porous Pavement Structures	Coventry University	Details the breakdown of oils, etc. through microbial ecology in the pervious concrete
Construction and Maintenance Assessment of Pervious Concrete Pavements	RMC Research & Education Foundation	
Hydraulic Performance Assessment of Pervious Concrete Pavements for Stormwater Management Credit	RMC	Addresses long term infiltration rates and rainfall retention which leads to an undefined credit for stormwater management

The Concrete Advantage – Reflectivity & Urban Heat Island Effect

The Urban Heat Island (UHI) effect is a phenomenon where the air temperature surrounding an urban, or metropolitan area, is significantly higher than the surrounding, more rural areas. This phenomenon occurs as vegetation is replaced with buildings, roads, and parking lots. The impacts of the urban heat islands are many: increased energy requirements for air conditioning and refrigeration, more rapid deterioration of heat sensitive materials, higher temperatures and resulting smog, increased concern for health issues and increased air pollution.

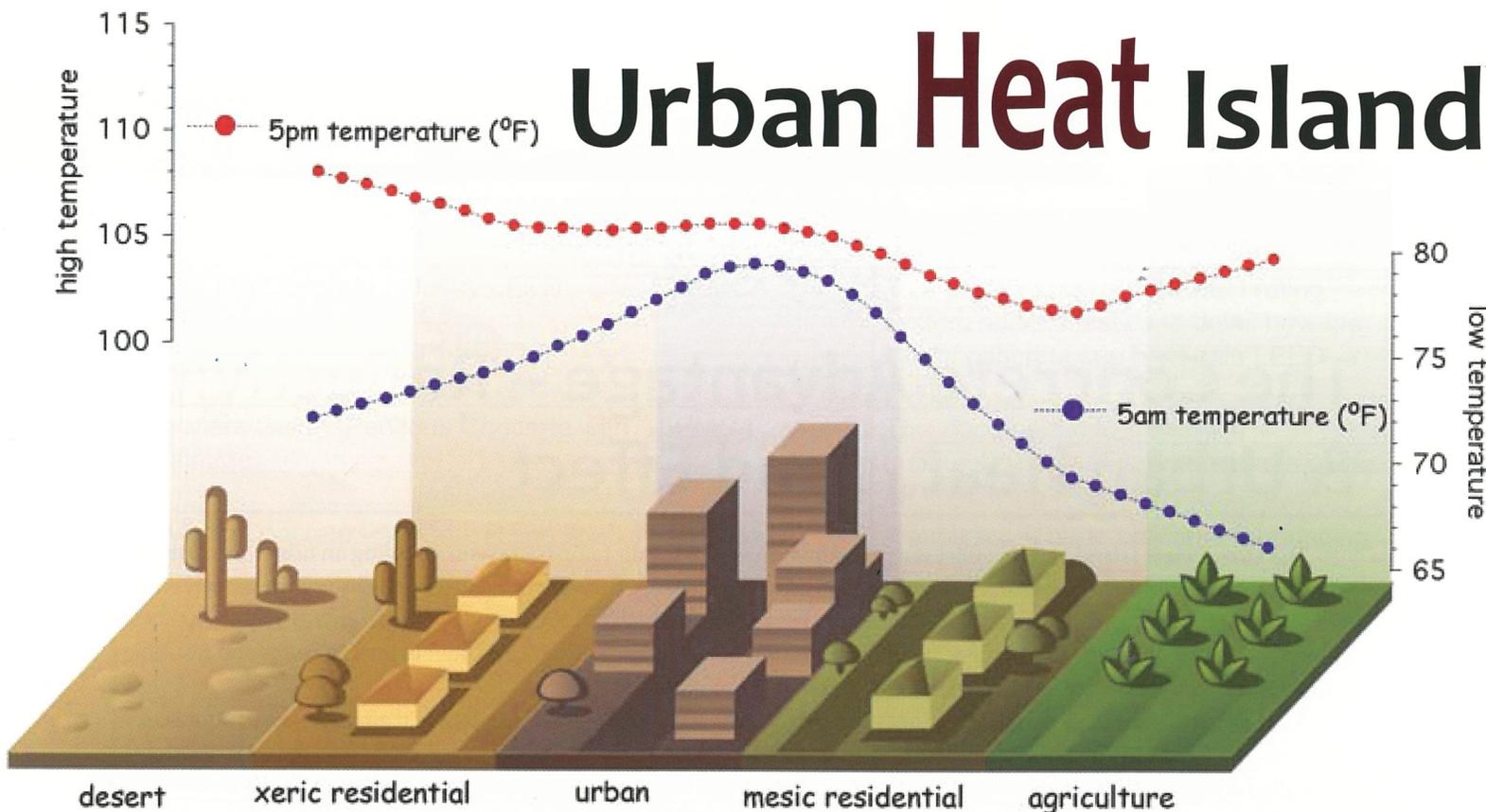
All hard surface materials absorb – rather than reflect – the sun's heat, causing surface and ambient temperatures to rise. The good news is that concrete reflects much more and thus absorbs much less heat than does asphalt! Reflectivity, also called albedo, is the measured amount of light reflected on a surface in comparison to the amount shone on the surface with 1.0 being perfect reflectance and 0.0 being total absorption. Pavements with higher albedos absorb less energy and are, thus, cooler. Consider the albedo numbers of these pavement surfaces:

Material surface	Solar Reflectance
Black acrylic paint	0.05
New asphalt	0.05
Aged asphalt	0.1
"White" asphalt shingle	0.21
Aged concrete	0.2 to 0.3
New concrete (ordinary)	0.35 to 0.45
New white portland cement concrete	0.7 to 0.8
White acrylic paint	0.8

Pervious concrete, discussed in the Stormwater Management section starting on page 37, can provide not only good reflectivity, but also it allows water to penetrate, keeping the pavement cool when moist. The air voids in pervious also promote cooler surfaces.

High reflectivity and low heat absorption are two more sustainable advantages of concrete.

Urban Heat Island



Graph courtesy of the national Center of Excellence SMART Innovations for Urban Climate and Energy at Arizona State University.

Climate Study

Urban regions are among the most rapidly changing environments on earth. As cities grow, they impact local and regional climates, including temperature averages and extremes. Urban areas are known to alter mean annual air temperatures by 2-5°F per 100 years and up to 20°F at night. Temperature changes affect urban dweller in many ways, influencing their health and comfort, energy costs, air quality and visibility levels, water availability and quality, ecological services, recreation, and overall quality of life. The climate section of the UHI initiative is about Analyzing Local and Regional Climate Changes: Past, Present-Day, and Prospects for the Future. In addition to analyzing temperature data - analysis of the circumstances surrounding historical and present day collection sites (location, area characteristics) is key.

What is the Urban Heat Island?

For nearly 100 years, it has been believed that urban areas affect the local climate, mainly in terms of the temperature. The urban effect is due to changes in the thermal properties, moisture and aerodynamic character of the built environment. These changes create a distinct urban boundary layer, or heat dome. This heat dome extends vertically above the city, and in windy conditions can be located downwind as a plume. The temperatures within the heat dome can be 10°F (6°C) higher than the surrounding areas.

At a given time of day, a balance of incoming energy from the sun and outgoing heat from the surface determines the surface temperature. Solar radiation strikes the surface, and reflects a portion back to space and with the remainder both heating the surface and evaporating any water that may be present. The heat is transferred upwards, in part by thermal (infrared) radiation and by turbulence due to the wind flowing over the surface.

In built urban areas, there is generally less water on the surface, as compared to the outlying rural areas. In addition, the walls of buildings radiate horizontally instead of vertically, which traps the heat near the surface. Both of these factors result in the elevation of temperature that is the urban heat island (refer to figure 1).

The low level heating over the cities also has low pressure associated with it. This results in a flow from the rural areas toward the urban center, with the air converging and rising over the city. This rising air can, if conditions are favorable, result in the triggering of thunderstorms over the city.

The higher temperatures within the urban dome can also increase the rate of some chemical reactions, and in particular, the formation of low-level ozone. As a result, the urban heat island can have a profound effect on human comfort and health.

This information is as found at the SMART Innovations website, www.asusmart.com/urbanclimate.php.

The Cool Solution to Sustainable Pavements

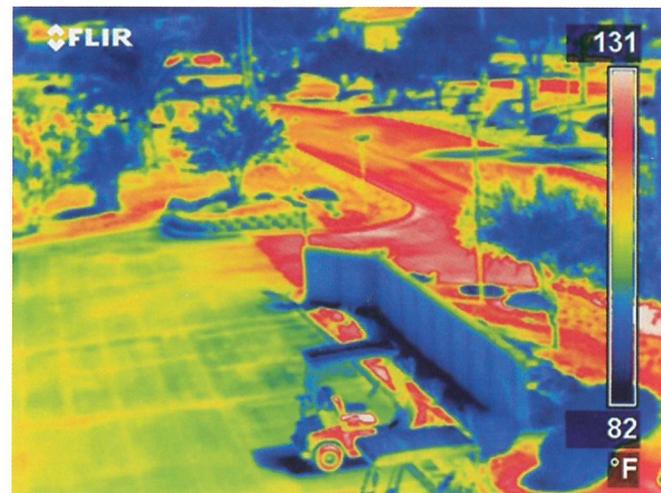
By Randell C. Riley, P.E.

Have you reached a “concrete” solution yet? It’s ingrained in our very language as an icon of permanence. Those of us in the concrete industry are well aware of the permanence of long-life concrete pavements, but other aspects of concrete pavements have captured the interest of some in the environmental community that are coming to recognize concrete paving as potentially the most sustainable of pavement types.

For example, every summer we each experience first hand the direct impact of something called albedo. By now most of you in the concrete industry have heard of it. Albedo results in that blast of hot air you feel when you walk across an asphalt parking lot heated by the sun on a summer day. Often you can still feel it late into the night. Most folks do not think about it, but in more ways than one that dark characteristic of asphalt costs each of us money. It creates higher demand for electricity for cooling as a result of daytime heating. It also creates higher demand for electricity at night due to the higher wattages required to light an asphalt pavement for security purposes.

In the photos shown at right, are images that clearly demonstrate the affect of albedo on pavement temperatures due to solar heating.

These particular pictures show an Ultra-Thin Whitetopping section of a parking lot adjacent to an asphalt road in Rio Verde, Arizona. The photo on the left is generated from an infrared digital imaging camera that provides an indication of the temperatures of the pavement surfaces. What is obvious from the picture is that the UTW section is several degrees cooler than that of the asphalt immediately adjacent to it.



Above are two types of images taken of the same location. In the top photo you see how concrete and asphalt pavements are adjacent. The bottom infrared photo demonstrates the dramatic temperature differences of the two pavements. **UTW is much cooler.** Photos courtesy of American Concrete Pavement Association.

The U.S. Department of Energy on its review of heat island technologies points out specifically that whitetopping with its typically higher albedo of 15 to 30 percent compared to typical asphalt pavement is a partial solution to the heat island effect problem.

This phenomenon is one of the major contributors to the "Urban Heat Island" effect and is one of the reasons that the City of Chicago and other communities are increasingly looking to lighter colored pavements in combination with landscaping and other techniques to keep their communities cooler. This in turn affects air conditioning demand and hence electrical demand within our communities. Since the major source of electricity today is coal-fired generating stations, asphalt parking lots are indirectly contributing to the CO2 loading in the atmosphere every single summer day – and night!

These higher temperatures which occur in the Urban Heat Island also contribute to increased production of smog and ozone within America's major cities. This, in turn, leads to respiratory distress amongst those susceptible, notably infants and the elderly. Expanded use of UTW in the nation's cities could well aid in eliminating these kinds of problems. In fact, the U.S. Department of Energy in its review of heat island technologies points out specifically that whitetopping with its typically higher albedo of 15 to 30% compared to typical asphalt pavement is a partial solution to the heating problem.

As a starting point for more information on concrete's higher albedo and to better understand how

to put this to a marketing advantage, go to <http://eetd.lbl.gov/HeatIsland/>. The information is voluminous, to say the least, as there is a tremendous amount of work going on in this area right now.

Note the photos at the bottom of the page. One store (left) has a concrete lot and the other (right) an asphalt lot. Which of these lots would you prefer on a dark Illinois evening? Which is the most secure and which requires the most energy to light to safe standards? Think about it.

Based on the information in a report published by the Portland Cement Association several years ago, *Road Surface's Reflectance Influences Lighting Design*, it is possible to estimate the additional lighting requirements needed to bring the level of lighting for the asphalt lot up to roughly the equivalent level of the concrete lot. Lighting calculations are particularly complicated, involving considerations of the type and height of fixture, the wattage of the bulb, the spacing, etc. However, in general for highway and pavement applications the report work indicated that it would take about 30% more in equivalent lighting fixtures to achieve the same level of lighting for asphalt as for concrete.

In general for highway and pavement applications the report work indicated that it would take about 30 percent more in equivalent lighting fixtures to achieve the same level of lighting on asphalt as compared to concrete.

Many of you have seen the below photos before. They were taken in the 90s in Springfield, Illinois, at an upscale services mall about two blocks from my house. Each facility used the same type and number of lighting structures and are virtually identical. The photos were taken minutes apart with the camera on a tripod using its own automatic light exposure settings for the conditions. Do you see a difference? It is hard not to! This results in significant differences, not just in terms of number of required lighting fixtures, but the ongoing energy demands necessary to light those fixtures.



For the astronomers amongst you, the International Dark-Sky Association (IDA), www.darksky.org, has made estimates of the costs of lighting, though for a different intended purpose. Their numbers are, however, illustrative for our purposes. According to IDA the average security light switched on by photocell burns about 4100 hours a year or on average about 11.23 hours per night and is irrespective of the latitude the light is placed as hours of usage balance out from winter to summer and northern hemisphere to southern hemisphere. (We are talking about astronomers here.) Using their hour estimate and applying this to calculate the additional cost to provide an additional 250 watt lighting unit to achieve the same luminance level of a concrete lot, we find that nearly 1,025 kilowatt-hours (kWh) would be required. At about \$0.085/kWh (the Illinois average cost as of Feb. 2008) that comes to about \$87 in additional cost per year just for electricity. Over twenty years for a facility this cost mounts up to \$1742, and this does not yet include the cost of the fixture. A quick perusal and ball-park figures from my bid-tabs database of Illinois Department of Transportation items indicates that the cost of a fairly typical metal light mast with luminare, foundation, wiring, trenching, etc. probably costs close to \$5500. (I'm no expert on this, but it looks reasonable.) The total on that is about \$7,250 just do to the difference in lighting.

But what about the impact on the environment? From another source of information I gleaned that the electricity generated per ton of coal is about 2460 kWh/ton at about a 40 percent efficiency rating which apparently is pretty good by utility standards. Therefore, in order to bring the level of lighting for asphalt up to the level of typical concrete pavement, it takes about another 0.42 tons of coal per year converted into electricity with another 0.6 tons of coal lost due to waste in the thermodynamic transfer effects, waste heat, etc. The net result of this would be a contribution of 2,167 lbs., say roughly a ton of CO₂ into the atmosphere per year every year of operation. This is just one measly two-acre parking lot!

Think about the parking lot at your nearest major mega-mall and what the implications are for those locations. And this isn't even looking yet at the air conditioning load being generated as a result of the additional heating stemming from the asphalt's lower albedo. But back to the albedo issue for a minute!

Did you know that concrete pavement albedo with some of our newer "green friendly" mixtures containing slag can be quite high? From a Transportation Research Board paper presented at the 86th Annual Meeting, *Mix Design and Benefit Evaluation of High Solar Reflectance Concrete for Pavements*, by Kanok Boriboonsomsin and Farhad Reza, albedo ratings measured on concrete incorporating slag in a range from about 0.34 to 0.58. Observations from space have determined that the Earth's albedo is about 0.39! On average our newer materials are cooler than the Earth.

There are those that think CO₂ is the problem contributing to global warming. I think it's asphalt pavement! Concrete pavements alone could turn the planet into a popsicle.

Randell Riley is the Executive Director/Engineer for Illinois Chapter – ACPA, and a consultant to Illinois Ready Mixed Concrete Association. He is actively and enthusiastically involved in the day-to-day building of partnerships and promotion of long-life quality concrete pavements. He can be reached at 217-793-4933 or pccman@ilacpa.com.

HOW does a Project Obtain LEED® Credit for Reducing Temperature in Heat Islands?

Concrete surfaces can earn a LEED for New Construction and Major Renovation (LEED-NC version 2.2) credit through Sustainable Sites Credit 7.1: "Heat Island Effect, Non-Roof". The intent of this credit is to reduce the heat island effect. The intent can be met if materials that stay cool in sunlight are used on at least half of the site's non-roof impervious surfaces, such as roads, sidewalks, courtyards, and parking lots (hardscape). The material's solar reflectance index (SRI) must be at least 29. Where paved surfaces are required, using materials with higher SRI will reduce the heat island effect, consequently saving energy by reducing demand for air conditioning, and improve air quality. Concrete and concrete pavers are ideally suited to meet this requirement. Ordinary portland cement concrete has an SRI in the range of 38 to 52, although it can vary. However, unless it is actually measured, LEED allows an SRI of 35 for ordinary portland cement concrete (see the LEED-NC Reference Guide). New concrete made with white portland cement has an SRI of 86 according to the Reference Guide.

Other options include placing a minimum of 50% of parking spaces undercover (such as underground, under deck, under roof, and under building); using an open-grid pavement system with more than 50% perviousness; or provide shade within 5 years of occupancy.

Information as found at www.concretethinker.com.

In addition to being ecologically-responsible, green roofs enhance the comfort and attractiveness of city living, according to Charlie Miller, president of Roofscapes, Inc, in Philadelphia, Pennsylvania. Currently the strongest green roof markets are Philadelphia, Washington, DC, and Chicago, though roof top gardens can increasingly be found in cities such as Portland, Seattle, Boston, Atlanta, Baltimore and New York.

Green Rooftops Are Fast, Smart and Economical with Concrete

Using Hydrophobic Pore-Blocking Ingredients (HPI's), waterproof concrete systems have proven themselves to be fast, smart and economical systems that can boost the greenroof industry.

These systems are fast because waterproofing is done right at the time of concrete placement, with no extra steps. They are smart because the technology is backed by a proven track record of over forty years and is not vulnerable to damage, reducing the liability of all parties. HPI's actually reverse the normal absorptive nature of hardened concrete, making it physically water-repelling and non-absorptive so it won't transmit moisture, dampness, or the salts and acids that the moisture may contain.

These systems are economical because of the initial cost/construction savings, as well as the significant long-term savings. Both bring down the cost of owning a structure with a green roof.

When truly waterproof concrete is specified for a green roof application, the owners know that they have a system which will not wear out or ever need replacement. They also know that if problems occur, there is a very simple identification and repair process that eliminates any need to disturb the growing medium.

Information as found at www.greenrooftops.org.

Heat Island Sites

Heat Island Effect – Environmental Protection Agency

<http://www.epa.gov/heatisland/>

Heat Island – NASA – Atlanta

http://www.ghcc.msfc.nasa.gov/urban/urban_heat_island.html

Atlanta's Urban Heat Alters Weather Patterns

http://science.nasa.gov/newhome/headlines/es-sd26apr99_1.htm

Heat Island Group – Lawrence/Berkeley

<http://eetd.lbl.gov/Heatisland/>

Mitigation Impact Screening Tool (MIST)

<http://www.heatislandmitigationtool.com/>

Goddard Space Flight Center

<http://www.gsfc.nasa.gov/scienceques2002/20021004.htm>

This image indicates in red urban areas with heat island effect in central and northern Illinois. It can be found at CIMSS Satellite blog, <http://cimss.ssec.wisc.edu/goes/blog/archives/685>.



The Concrete Advantage – Look Who’s Involved

Leaders of every organization in the world involving concrete have recognized the many sustainable advantages that concrete has over competitive products and all are doing everything they can to make sure that all levels of decision makers get the word. Millions of research, development and publicity dollars have been spent by organizations such as the National Ready Mixed Concrete Association, the RMC Research and Education Foundation, The Portland Cement Association, the American Concrete Pavement Association, the American Concrete Institute, the National Association of Home Builders, the Insulating Concrete Forms Association, ASTM, the US EPA, the Illinois Ready Mixed Concrete Association, and many more.

Each of these organizations and virtually all who are involved in the concrete industry operate web sites that are loaded with information on the sustainability advantage of concrete. The purpose of this section is to give readers some guidance on what’s out there and how to access it. The concept of the concrete advantage is growing exponentially!

The cement and ready mixed concrete industry's commitment to sustainable development is as strong as it has ever been. There is no doubting the importance of the global move toward sustainability, and no one is doing more than the companies in this sector to see it through.

The efforts are evident in the manufacturing process, where plants are conserving energy and decreasing emissions; in the end results, where sustainable products are used to produce homes, buildings, and other structures; and in the overall corporate culture. Check the Web page of any major cement/ ready mixed concrete company and you'll find a "sustainable" section prominently featured. The companies compile special reports on sustainability and go to great efforts to communicate their values, goals, and results. The industry as a whole has combined efforts through a number of initiatives. "Sustainable development" is a popular phrase, but what does it really mean? Here's a standard definition that has been cited in NRMCA presentations: Sustainable development is development that meets the needs of the present generation without compromising the needs of future generations. It encompasses all aspects of our impact on the earth: shelter,

Sustainable development is development that meets the needs of the present generation without compromising the needs of future generations.

Building with the Future in Mind

The Industry is Dedicated to Sustainable Practices

By Jim Ross

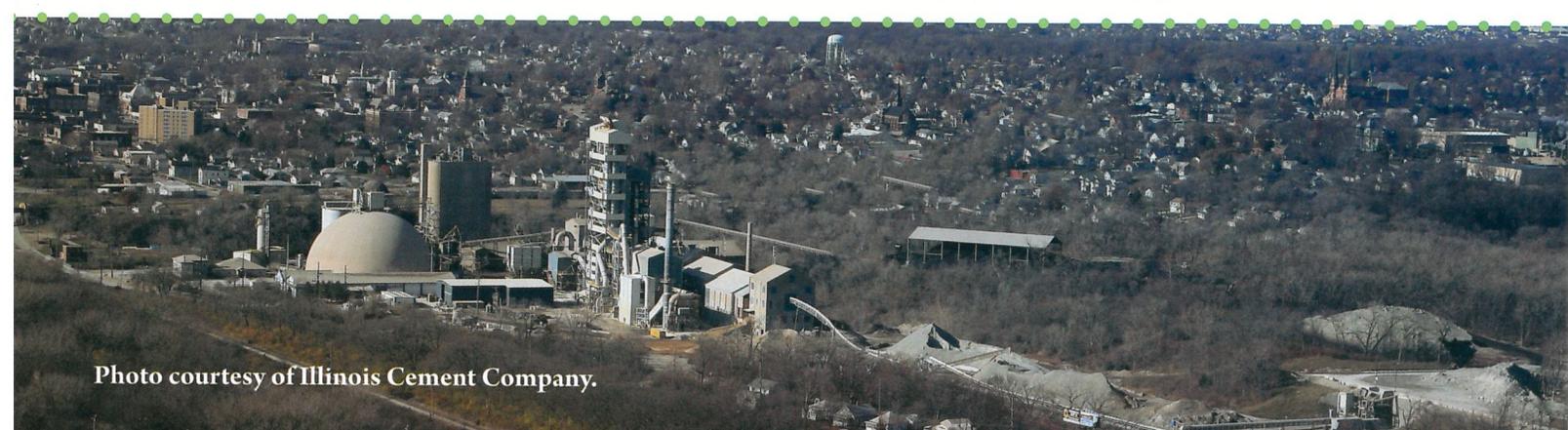
food, social welfare, health, ecology, etc. To be truly sustainable, one must leave the earth in equal or better condition for the next generation.

So, sustainability isn't some slogan. It's a complete way of doing business. It isn't limited to scientific readings. Sustainability is also about people. This article will explain how industry in general has embraced sustainability and how some of the industry's leading corporations are specifically dedicating themselves to this task.

INDUSTRY AS A WHOLE

Cement is a critical part of the ready mixed concrete, so any discussion of sustainability must begin there. The Portland Cement Association (PCA) notes that domestic cement production accounts for less than 1.5% of the U.S. carbon dioxide emissions. Still, the cement industry is one of the biggest energy users among manufacturers, spending more than \$1.2 billion per year. There is a national push to reduce energy use - and to reduce emissions - so the industry is always looking for better, more environmentally friendly methods to use in manufacturing. And it's willing to set tough goals for itself.

Photo courtesy of Illinois Cement Company.



In early 2003, the cement industry committed to reducing carbon dioxide emissions by 10% (from a 1990 baseline) per ton of cementitious product produced by 2020 according to the PCA. The industry also aimed to reduce by 60% (also from a 1990 baseline) the amount of cement kiln dust (CKD) disposed per ton of clinker produced by 2020.

Discussions are underway for a third target: focusing on plant-level implementation of environmental management systems, the PCA says.

In June 2004, the Cement Manufacturing Sustainability (CMS) Program was created. It's a joint effort of the PCA, its member companies and federal agencies. The program includes a voluntary code. Manufacturers that adhere to the code agree to continue current environmentally sound practices and improve in seven areas. (Again this list comes courtesy of the PCA.)

- Place the highest value on the safety and health of employees, neighbors and customers when producing and distributing cement.
- Implement effective controls that reduce or eliminate the release of pollutants to the air, land, and water.

- Seek ways to manage wastes in responsible and environmentally sound manner.
- Pursue improvements in energy efficiency and promote resource conservation.
- Seek ways to safely use recyclable wastes as raw materials, fuels and product components.
- Conduct mining operations in a responsible and environmentally sound manner.
- Participate with lawmakers, regulators and others to develop rational and effective environmental laws and regulations.

The program isn't just a side issue for the cement industry. It is part of a multi-faceted response to the pressing problem of greenhouse gas emissions. President Bush wants to reduce those emissions by 18% by 2012.

Also helping to meet that goal is the Climate VISION program, a public-private partnership whose officials work with industry to find ways to improve production and develop/adopt environmentally sound tools. Cement is one of 12 participating industrial sectors, the PCA says.

According to the PCA, the industry has a three-part strategy to help with the VISION goals:

- Energy efficiency: Since the 1970s, energy consumption has gone down 33%, but U.S. plants continue to upgrade and improve.
- Product improvements: such as including up to 5% of crushed limestone, as well as industrial by-products like fly ash, to help reduce carbon dioxide manufacturing.
- Develop new applications.

The industry also participates in ENERGY STAR, a government program that offers businesses and consumers energy-efficient solutions. The goal: to help consumers save money and to help protect the environment.

The cement industry held a forum in May 2004 that yielded a guide, *Energy Efficiency Improvement and Cost Savings Opportunities for Cement Making: An ENERGY STAR Guide for Energy and Plant Managers*.

There also are other groups, such as the World Business Council for Sustainable Development (WBCSD), a coalition of 175 international companies. Working with that coalition is the Cement Sustainability Initiative, a collection of 10 major cement companies that started in 1999.

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Photo courtesy of Continental Cement Company.





American Concrete Institute® *Advancing concrete knowledge*

In their most recent strategic plan update, ACI identified sustainable concrete as a needed focus. First, it was a board advisory committee who focused on sustainability matters, but now a newly formed technical committee, ACI-130, Sustainability of Concrete, has joined the effort. ACI-130 chair, Richard Stehly of American Engineering & Testing in St. Paul, MN, says that ACI is working through this committee to develop information that will help people deal with the changes related to sustainability issues, including improving environmental footprints. Their mission is to develop and report information on the sustainability of concrete and current goals include:

- Fulfill the goals and objectives of the ACI Strategic Plan that target sustainability
- Lead efforts that position concrete as sustainable and environmentally friendly
- Write a report/guide by 2009 that contains current information regarding concrete's environmental footprint, data to input into evaluation models or calculators, and strategies or methods to improve the environmental footprint.

For more information about ACI's services and activities visit www.concrete.org.

National Association of Home Builders

The National Association of Home Builders (NAHB) launched its NAHB National Green Building Program in February of 2008. This program will encourage and educate builders to build green homes while keeping the home cost affordable. Modeled after other rating systems, builders receive points in several areas, including those in which the use of concrete helps acquire points, such as site development and water efficiency. NAHB has developed a web site, www.nahbgreen.org that will lead the builders through steps necessary to qualify for an inspection by local green experts who will verify the project.

American Concrete Pavement Association

ACPA is the premier national association representing the concrete pavement industry. Their mission is to make portland cement concrete the material of choice for airport, highway, street, and local road pavements. The ACPA offers its members technical, marketing and advocacy support in meeting the mission. Almost every state has a local ACPA Chapter. The Illinois Chapter is located in Springfield and Randall Riley, P.E. is executive director. The primary web site for the ACPA, www.pavement.com offers visitors details on the broad spectrum of activities and opportunities that accompany concrete pavements.

ACPA also recognizes that concrete pavements can and should play an important role in the areas of noise and environmental sustainability. In its publication "Green Highways – Environmentally and Economically Sustainable Concrete Pavements", the ACPA discusses in detail topics that highlight concrete pavement sustainability, such as longevity, reduced deflection, lower fuel consumption during construction, use of industrial by-products, pavements being renewable and 100% recyclable, less need for sub-base, increased reflectivity, pervious possibilities, and quieter pavement. This document can, and should, be downloaded by accessing www.pavement-4life.com and clicking on "Environmental Advantage."

Using this same web site (also under "Environmental Advantage") viewers can access a video presentation in which non-partisan ecology experts explain how lighter surfaces – roads, parking lots, and rooftops – can help mitigate the "heat island effect". There are several other pieces of information on this site that further edify readers on the concrete advantage!

All the benefits listed above and more result in concrete remaining, as it always has been, the longevity and sustainable choice for pavements everywhere. The color may be white, but concrete roads are really GREEN!

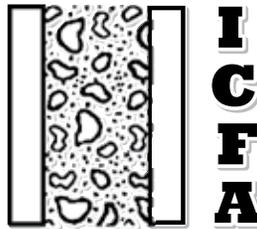


Insulating Concrete Form Association

The Insulating Concrete Form Association (ICFA), headquartered in Glenview, Illinois, leads the industry in spreading the word about the sustainable advantages of ICFs. They offer many services, including:

- Periodic technical bulletins detail research sponsored by ICFA and allied associations on topics such as energy efficiency, structural performance, fire and sound transmission, etc. This information can be located in ICFA's Technical Library located on the website, www.forms.org.
- The ICFA Excellence Awards, given annually is the premier industry recognition of the most innovative and noteworthy ICF projects of the year.
- ICFA participates in many national and local promotion events such as educational seminars and demonstration projects of their own and in partnership with regional cement and concrete promotion groups throughout North America.
- ICFA represents our industry at building codes hearings to advance the use of ICFs through code changes and standard writing.
- ICFA works with project engineers to acquire LEED points and federal energy tax provision.

Through ICFA's primary activities in promotion, codes and standards, research, partnering and education, the association plays a leading role in the ICF revolution that is changing the face of residential and light commercial construction.



The web site, www.icfhomes.com, was developed to provide a networking forum for builders, home owners, those building a home, designers, architects, engineers, ICF professionals, and any others who wish to learn more about the best value in construction available. It provides education and resources to those who are interested or involved in Insulating Concrete Forms (ICFs).

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Key Sustainable Development *Initiatives*

NATIONAL RESOURCES PROGRAM FOCUSES ON GREEN BUILDING OPPORTUNITIES

NRMCA National Resource Directors (6) are located strategically around the country. As they promote concrete on a consultative basis to the largest potential users of concrete in both the private and public sectors, they are frequently positioned to represent the potentials for building green with concrete.

PERVIOUS CONCRETE CONTRACTOR CERTIFICATION

NRMCA developed a certification program for contractors qualified to place pervious concrete. The goal of the certification program is to ensure that knowledgeable contractors are selected to place the product and thereby maximizing successful installations. The program is designed to be administered locally by local sponsoring groups in conjunction with training sessions. NRMCA grades exams and awards certificates for three levels of certification: Technician, Installer, and Craftsman.

PERVIOUS CONCRETE DESIGN SEMINARS

The seminar provides detailed instruction on pervious concrete pavement as a solution to reducing storm water runoff from building sites and other paved areas.

CONCRETE'S ROLE IN SUSTAINABLE DEVELOPMENT COURSE

The course provides a detailed understanding of the design concepts and guidelines used in the green building movement such as LEED and Green Globes.

2008 CONCRETE TECHNOLOGY FORUM: FOCUS ON SUSTAINABLE DEVELOPMENT

NRMCA sponsors the annual Concrete Technology Forum

NRMCA SUSTAINABLE CONCRETE PLANT CERTIFICATION

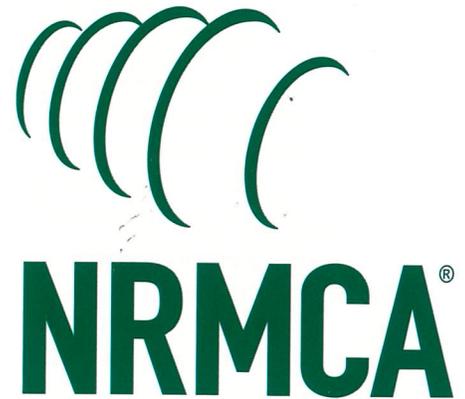
The certification recognizes the use of Environmental Management Systems as a tool for environmental benchmarking and improvement.

THE P2P INITIATIVE

Through NRMCA, the concrete industry has implemented the P2P Initiative (Prescriptive to Performance Specifications for Concrete) which provides concrete producers with more flexibility to optimize concrete mixtures to reduce environmental impact.

MODEL ORDINANCES FOR SUSTAINABLE CONSTRUCTION

NRMCA established the Building Codes and Sustainability in 2007. The scope of the committee is to coordinate building code and sustainability standards activities of NRMCA. The committee works with other NRMCA committees, State Affiliates, and national allies to support and promulgate the adoption of buildings codes and sustainability standards where none exist and helps develop and support amendments to local and national codes where they are deficient.



2008 GREEN BUILDING AWARDS

The award program is aimed at showcasing concrete projects that demonstrate excellence in green building construction and uphold sustainable development principles.

RESEARCH

Since 1928, NRMCA's Research Laboratory has been a forerunner in testing and research by establishing technical standards for the industry. Now located in College Park, MD, near the campus of the University of Maryland, the lab has been involved with a number of leading industry research projects in support of sustainable development and environmental performance. Examples include:

- Obla, K., Kim, H., and Lobo, C., "Crushed Returned Concrete as Aggregates for New Concrete"
- Lobo, C., and Mullings, G.M., "Recycled Water in Ready Mixed Concrete Operations"
- Ongoing research: "New Technology Based Approach to Advance Higher Volume Fly Ash Concrete with Acceptable Performance"

NRMCA Develops Model Stormwater Ordinance Promoting Pervious Concrete

The National Ready Mixed Concrete Association (NRMCA) has developed a model stormwater ordinance that promotes the use of pervious pavement systems. Pervious pavement systems are a unique way of handling and treating stormwater onsite. Generally, they consist of a pervious pavement layer capable of supporting vehicular or pedestrian traffic along with a detention or storage layer consisting of gravel or crushed stone with sufficient voids to allow stormwater to collect and infiltrate into the soil below. Pervious pavement systems minimize stormwater runoff, recharge local groundwater supplies and help minimize the environmental effect of land development.

When pervious pavements are used for parking areas, streets, plazas and walkways they minimize stormwater runoff to surrounding streams and lakes and allow for natural infiltration to recharge local groundwater supplies. Although pervious pavements have been used in some areas for decades, recent interest in green building and recognition of pervious by the U. S. EPA as a best management practice (BMP) for stormwater has increased its use throughout North America. Its use supports national initiatives such as Low Impact Development and Cool Communities and provides a credit in the LEED green building rating system. Pervious pavement systems reduce the need for expensive storm-

water drainage and wet pond retention systems, thereby allowing for more economical and beneficial land use.

The model stormwater ordinance was developed in consultation with numerous stakeholders, including concrete industry members, civil engineers, environmental advocates, and consultants in the field of stormwater management. The ordinance aims to give local governments a starting point for developing a stormwater ordinance that includes pervious pavement systems. It should be adjusted to accommodate local conditions. The model ordinance also includes minimum requirements for pervious concrete.

A copy of this ordinance is available for download at www.nrmca.org/Codes/ModelCodes.asp or by contacting the NRMCA office.

Recent interest in green building and recognition of pervious by the U. S. EPA as a best management practice (BMP) for stormwater has increased its use throughout North America.

CONCRETE THINKER

Not long ago a group of allied promoters in the Pacific Northwest came up with the idea to create a clearinghouse on sustainable attributes of concrete. After researching options they brought their idea to the Portland Cement Association (PCA) and the concept was further developed to include a city tour that highlights the sustainable concrete features. The PCA executive board approved the project and Green Building Consultants was hired to create the Concrete Thinker web site, www.concretethinker.com, and to help write content appropriate for the target audience - architects, engineers, government officials and building owners. CTL provided the technical review and wrote much of the web site content.

Concrete Thinker enjoys more than 12,000 unique visitors a month. In addition to the city tour, found on the home page, 19 sustainable solutions topics and more than 50 case studies are available. Another popular feature is the e-newsletter, which has approximately 9600 subscribers.

SUSTAINABLE LEADERSHIP AWARDS

This year PCA is selecting the first recipients of its Sustainable Leadership Awards, which honor government leaders who advance sustainable development in their communities through the use of concrete and cement-based products.

CONCRETE THINKING FOR A SUSTAINABLE WORLD STUDENT DESIGN COMPETITION, SPONSORED BY PCA AND NRMCA

In this competition students are challenged to investigate innovative uses of portland cement-based material to achieve sustainable design objectives. This is the third year for the competition; 8 countries, 50 universities and 79 faculty sponsors were represented by 842 student entries.

PCA REPORT ON SUSTAINABLE MANUFACTURING

This annual publication corrects perceptions about the manufacturing industry and offers solutions to their customers.

The RMC Research & Education Foundation is growing strong and putting the generous contributions of the concrete and construction community members to work to fund programs that are helping to improve an already superior product in an industry committed to excellence.



R M C

Recent or current Environment, Health & Safety Track research includes:

- Effect of Pavement Type on Fuel Consumption and Emissions
- Side-by-Side Comparison of Pervious Concrete & Porous Asphalt
- Performance Assessment of Pervious Concrete and Maintenance Plan
- Air Emissions Testing Program at Ready Mixed Concrete Plants
- Ready Mixed Concrete Industry LEED Reference Guide
- Sustainability Vision Roadmap for the Concrete Industry
- Hexavalent Chromium Personal Exposure Study

For more information, visit www.rmc-foundation.org.

Pervious Concrete/Sustainable Development Resources

In March 2008, the RMC Research & Education Foundation released the CD *Research Supporting Sustainable Development*.

The World Business Council

f o r Sustainable Development

The Cement Sustainability Initiative

The World Business Council for Sustainable Development (WBCSD) is a CEO-led, global association of some 200 companies dealing exclusively with business and sustainable development. Its mission is to provide business leadership as a catalyst for change toward sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues. The Council provides a platform for companies to explore sustainable development, share knowledge, experiences and best practices, and to advocate business positions on these issues in a variety of forums, working with governments, non-governmental and intergovernmental organizations. To address these issues and to provide vision and direction for a more sustainable approach to the cement industry's future growth, the WBCSD worked with the industry to carry out a sector project on cement.

The Cement Sustainability Initiative (CSI) was formed within the WBCSD by cement company owners to help the cement industry to address the challenges of sustainable development. Core Members of the Cement Sustainability Initiative (CSI) include cement companies who are also members of the World Business Council for

Sustainable Development. This group of companies represents more than half of the cement manufacturing capacity outside of China.

In 2002, after 3 years of research, the members moved forward with an ambitious 5-year set of task forces and projects dealing with: climate protection and CO₂ management, responsible use of fuel and materials, employee health and safety, emission monitoring and reporting, local impacts on land and communities, and reporting and communication.

A progress report was published in 2007. It gives an update on the Initiative's interim progress (2005), and outlines future sustainability challenges facing CSI members. This report can be accessed at www.csiprogess2007.org.

The CSI wants to work with others to find ways to be more eco-efficient, accomplishing ever more with ever fewer resources, less waste, and less pollution. The industry understands that it has a responsibility to understand and promote sustainable development.

Note: This article was generated from information found on the WBCSD web site – www.wbcd.org and on the Cement Sustainability Initiative (CSI) web site – www.wbcdcement.org. Access these web sites for greater detail on these organizations and their initiatives.

- *The cement industry employs about 850,000 workers in facilities in 150 countries, producing about 1.5 billion tons of cement a year. It has an estimated annual turnover of \$87 billion and has grown by nearly 4 percent a year over the past decade*
- *The cement industry operates in over 150 countries, yet almost half of the world's cement is produced in China*
- *According to the Netherlands Environmental Assessment Agency, China's carbon dioxide emissions in 2007 were about 14 percent higher than the United States and accounted for two-thirds of the global rise.*

The future belongs to those who know how to manage the present.
Those entities who are not investing in the environment and sustainability will not be able to catch up later. -- Maurice Strong, former Secretary General of the United Nations Conference on Environment and Development (AKA Earth Summit)

The idea is to share the planet and its resources, not just with those alive today, but with those who will follow. -- David Darwin, President of American Concrete Institute



Wally, I said *concrete* blocks!

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Annie O'Connor - *Account Manager*

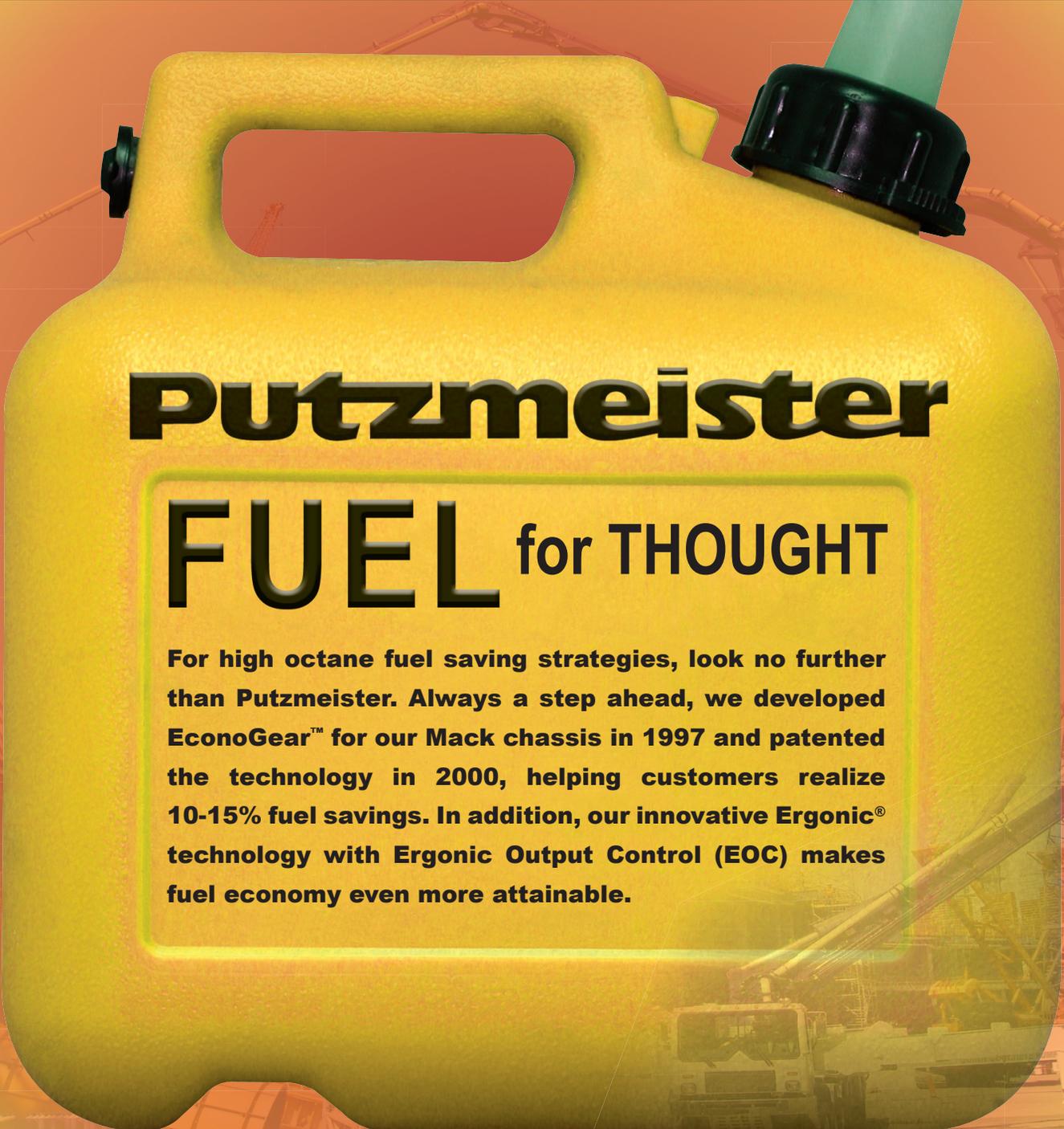
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